US Army Corps
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Water Resources Support Center

Procedural Guidelines for Estimating Residential and Business Structure Value for Use in Flood Damage Estimations

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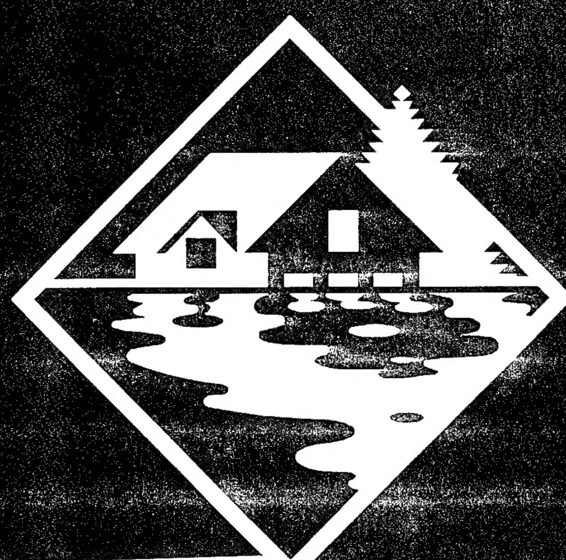

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PROCEDURAL GUIDELINES FOR ESTIMATING RESIDENTIAL AND BUSINESS STRUCTURE VALUE FOR USE IN FLOOD DAMAGE ESTIMATIONS

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PREFACE

This report was completed by URS Consultants, Inc./RBA Group Joint Venture under the direction of the Flood Mitigation, Formulation, Planning and Analysis research work unit at the Corps of Engineers (COE), Institute for Water Resources (IWR). Mr. Stuart Davis is the principal investigator for the research unit. The Flood Mitigation work unit is part of the Planning Methodologies research program, which is under the direction of Mr. Michael R. Krouse, Chief of Technical Analysis and Research Division at IWR. Mr. Steven R. Cone is the technical monitor of the Flood Mitigation work unit, under the direction of Mr. Robert M. Daniel, Chief of Economics and Social Analysis Branch at the Office of the Chief of Engineers. Mr. Cornell Pippens of the New York District served as district level coordinator for this effort. Mr. Robert F. Norton provided technical editing of the document. Ms. Arlene Nurthen was responsible for document preparation and publication.

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In addition, assistance in finalizing this document was provided by various COE divisions and districts. Special thanks are extended to Mr. Peter Shaw of the Southwestern Division, Mr. Edwin Woodruff of the North Pacific Division, Ms. Mona King of the Los Angeles District, and Ms. Patricia Obradovich of the Portland District, for their insights and comments on earlier drafts.

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Chapter 1
Introduction

Purpose

This document is intended to provide insight into the use of structure value to estimate the expected monetary cost of flood damage to the national economy. In order to accomplish this objective, the report presents an overview of valuation concepts, with descriptions of the role of each concept in the Corps of Engineers planning process. This information on the various uses of structure values is intended to assist the reader in understanding that there is more than one correct measure of value, depending on the perspective of the person establishing that value and the end use of the estimate. From the perspective of flood damage assessment and the use of depth-damage curves, the value of material and labor resources represented by the structure is the correct measure of the structure's value.

Since depth-damage curves are commonly used where damages are typically expressed as a percentage of structure value, it is necessary to quantify this value of material and labor resources. In this capacity, "...the correct measure of structure value, consistent with cost-benefit concepts, is replacement cost less depreciation to the existing (pre-flood) structure." (Engineering Regulation 1105-2-100, Dec. 1990, p.6-149) It is important to understand the relationship between this, the desired result, and other often more accessible sources and measures of value. In order to implement the risk-based planning concepts described in Engineering Circular 1105-2-205, it is also important to understand the sources of uncertainty associated with any estimate of structure value.

Possibly, the most important purpose of this manual is to identify current techniques to directly estimate depreciated structure replacement costs. Various architectural, engineering and condition analyses are summarized to define and supplement the current procedures for estimating both depreciation and replacement cost. Through the following chapters, this manual will attempt to provide guidance on techniques that can be used to determine depreciated replacement costs, both from a cursory exterior inspection and from a detailed interior inspection. In addition, the document will explore conditions in which surrogates such as market value and tax data may be used as a tool to obtain depreciated replacement value. The use of construction cost models, such as Marshall & Swift or E.H. Boeckh, to verify surrogate data will be presented. The manual is not intended to replace user manuals developed by organizations such as Marshall & Swift, E.H. Boeckh, R.S. Means or others, but rather to provide insight into how such manuals can be applied to the economic analysis of the Nation's floodplains.

Flood Damage — The NED Perspective

In evaluating the cost of flood damages from a national perspective, damaged goods must be assessed a value based on contribution to the National Economic Development (NED). The NED concept implicitly assumes that the beneficiaries of flood control would be willing to pay an amount equal to the value of damages prevented. As described in National Economic Development Manual - Urban Flood

Damages, March 1988, willingness-to-pay is considered the standard for all NED benefits, and that "Goods and services that are provided by the project have value only to the extent that there is demand by the customer."

Measures of damage from the NED perspective exclude many costs important to the owner of the structure, such as business losses due to sales which are transferred to a competitor. While the business owner may suffer a severe loss of income or extreme hardship due to interruption of operations, the cost to the national economy is limited to losses in efficiency associated with the economic transfer. In the context of this manual, more important non-NED costs are any building improvements or upgrades required for flood damage repairs to meet current building codes or functional design standards. While costs such as installing an elevator to meet requirements of the Americans With Disabilities Act represent a very real and significant cost to a financially stressed flood victim, the theoretical NED perspective assumes that this improvement provides benefits to society, including the property owner, which offset the cost of the improvement. Generally, the correction of any functional or physical deficiencies in a structure are excluded from the NED estimate of flood damages.

> *When determining structure values for use in calculating flood damage, the analyst must remember that the NED perspective applies to flood damage, not to the structure value. In determining flood damages, depreciated replacement value is the NED measurement of structure value.*

The Role of Structure Value in the Flood Damage Analysis

Structure value has evolved as the most widely used indicator of potential flood damage. Numerous Corps of Engineers Districts and the Flood Insurance Administration have developed generalized damage functions relating structure damage to percent of structure value at various depths of flooding. Similar curves relate content damage to a percent of content value. In most studies, the flood damage analyst estimates the value of contents as a percentage of the structure value. Flood damage estimates for many studies are therefore completely and directly correlated to the structure values used in the analysis.

In utilizing generalized damage functions, the analyst should understand the basis of the data used to generate the percent damage relationships. IWR Report 92-R-3, Catalog of Residential Depth - Damage Functions used by the Army Corps of Engineers in Flood Damage Estimates, states that 24 out of 38 district offices surveyed use some form of the Flood Insurance Administration depth-damage functions. As described in that report, the FIA curves are updated through the "Rate Review" process, and represent a blend of theoretical base tables and actual flood damage claims.

The structure value used by FIA for standard flood insurance policies is actual cash value (ACV), defined as replacement cost less physical depreciation. Within certain limitations, FIA offers total replacement cost coverage for primary residences. Some of the FIA data therefore reflects replacement costs rather than ACV. During the claims process, the insurance adjusters are required to estimate the ACV

of the damage, both the contents and the structure. This analysis is typically performed using depreciated cost techniques.

Intended Audience

Understanding the role of structure value as a surrogate indicator of flood damage is important to all participants in the plan formulation process. Clearly, the economist must be fully aware of all issues which impact the determination of flood damages. Real estate representatives should be cognizant of the distinctions in the use of structure value as an indicator of flood damage vs. the use of structure value as project or NED costs. When making judgments between designing around the structure or acquiring the structure, the design engineer must be aware of the suitability of the available data for use in balancing between structure acquisition and construction costs.

In order to avoid inappropriate applications of a structure value, it is advantageous that all members of a study team be cognizant that there is more than one way of calculating structure value and be made aware of the appropriate application of each intended use of the data.

Scope of the Document

This document is intended as a guide for estimating structure value with regards to predicting flood damages. The document presents a general review of some current COE procedures in structure valuation, a general discussion of theoretical structure valuation techniques, and sample guidelines of valuation methods. The organization of the remainder of the document is described below.

Chapter 2 discusses the theoretical basis of various methods for structure valuation. In this discussion, the correlation between the valuation method and the purpose and goals identified in Chapter 1 is presented.

A brief review of current COE practice in using structure value in the analysis of flood damage is presented in Chapter 3. Based on the information obtained from the review of COE practice and the correlation to the goals previously identified in Chapter 1, practical applications of a select group of structure valuation methods are also presented in this chapter. Primary sources of data and general procedures are presented for these methods.

Chapter 4 presents the more detailed sample procedural guidelines to be utilized to estimate structure value. Explanations of field data collection procedures and important analysis considerations are identified for two levels of detail appropriate for use with different levels of study budget.

Following the detailed guideline presentation, Chapter 5 documents five case studies of actual properties and presents a demonstration of structure value determination. Three non-residential and two residential properties serve as the structures for the case studies.

Chapter 6 includes information for the process of deciding when other approaches can be used as a surrogate when the depreciated replacement value method is not appropriate. The measurement of uncertainty and confidence levels for use in a risk-based damage analysis are presented.

This document is intended to serve as a supplement to the documentation associated with any selected valuation or cost calculating procedure. The analyst must fully understand the assumptions and limitations of the procedure selected and must thoroughly review the appropriate user manuals.

Finally, this manual is not appropriate and should not be used when estimating structure values as part of cost estimates. Project and/or NED costs are required to reflect market value in accordance with specific appraisal standards. The inappropriate reliance on the procedures described in this manual will generate unacceptable estimates of project or NED costs.

Chapter 2
Theoretical Valuation Applications

General

In establishing the concept of value, the first criterion is its supportability. The estimate of value should be based on logical evidence and fact which can be supported by documentation. All items considered as indicators of value must have a firm foundation in fact. Ideally, costs should be based on the actual end cost of the structure to the user. These costs will reflect typical labor efficiency, cost of money, fees, and many other items which are not included in the basic costs of labor and materials.

In valuation literature, five approaches to value are nearly always discussed: **Reproduction Cost**, **Replacement Value**, and **Depreciated Replacement Value** (often grouped together as Cost Approaches); **Market Value**; and **Income Capitalization**.

Each of these theoretical techniques has specific advantages and disadvantages from any perspective of structure value. However, what is important in the context of this document is their impact on flood damage analysis. The following paragraphs discuss the advantages and disadvantages of each technique from the flood damage analysis perspective.

Reproduction Cost

Description

Reproduction cost is the current cost of *duplicating* an *identical item* or *reproducing* an *exact replica*, including all of the item's deficiencies, superadequacies, and obsolescence. The market should be studied to determine actual up-to-date cost of specialty construction. Costs are based on actual end costs of the structure to the owner, including indirect costs, such as architectural design. Since reproduction costs reflect the cost to produce an exact replica of the damaged item, this technique is typically employed when estimating value of historical structures.

> *Reproduction cost is the current cost of duplicating an identical item or reproducing an exact replica, including all of the item's deficiencies, superadequacies and obsolescence.*

Advantages

Reproduction costs are beneficial in estimating structure damage since items of unique or unusual value will be included in the damage base. In addition, since the cost is related to the construction resources incorporated in the structure, land values are not included in the value and therefore do not need to be separated from the estimate. Reproduction costs may be the only way to consider the superior work and materials found in some older construction.

Disadvantages

The materials and construction techniques of many older structures have been superseded by more economically efficient and functionally equivalent techniques. In most cases, the value to society of the resources contained in the structure is equal to the value of functionally equivalent construction, and therefore this method may overstate the value from a flood damage analysis perspective.

Replacement Value

Description

Replacement value is the current cost of a *similar new item* having the nearest equivalent utility to the item being replaced. Unlike reproduction cost, the item being replaced does not need to be replaced with an *exact replica* including all the item's deficiencies, superadequacies and obsolescence. Replacement value relates specifically to the cost of providing a new item with the closest usage to the damaged item. The construction market needs to be evaluated to determine the actual up-to-date cost of a structure.

> *Replacement value is the cost of physically replacing the structure with a structure of equal utility.*

Advantages

Replacement value is not overly sensitive to interest rate fluctuations or temporary local economic conditions. However, replacement value is sensitive to location/local construction practice and local cost variation. This incudes local climate influenced construction variations, such as heating, cooling or snow load-bearing requirements, and differences in labor and material costs. Land value is inherently excluded from the estimate, thus structure value is obtained directly. Replacement cost is also highly correlated to the building size, which has been shown to be a significant indication of residential content value in Guidelines to Estimating Existing and Future Residential Content Values: IWR Report 93-R-7.

Disadvantages

Replacement costs do not account for inadequacies in the structure due to physical deterioration or functional obsolescence. Accordingly, the predicted value of the component resources contains an improvement or extended life which contradicts NED Planning criteria.

Depreciated Replacement Value

> *Depreciation accounts for deterioration occurring prior to flooding, and variation in remaining useful life of structures.*

Description

Depreciated replacement value is the cost of restoring or replacing a property with something of equivalent value, accounting for physical deterioration and functional

obsolescence brought on by age or lack of maintenance. When using this cost approach, external market factors may be included to determine value impacts to the structure in addition to physical and functional deterioration of the resource.

"Value of Structure" is equivalent to the replacement cost less depreciation. Depreciation is determined by inspection of the physical condition, plus allowances for observed obsolescence, utility, and present local economic conditions. The three basic elements of depreciation are:

1. Physical Deterioration is the combination of wear and tear of use, the effects of the aging process and physical decay, action of the elements, structural defects, etc. Deterioration is typically divided into two types -- curable and incurable, both of which contribute to depreciation.

2. Functional Obsolescence is the market reaction to the under or over improvements in buildings and the desirability of part or all of these improvements. Depreciation reflects both curable and incurable obsolescence. In a home, for example, the lack of a second bathroom is a potentially curable inadequacy. Insufficient ceiling height, however, is unlikely to be curable within a reasonable cost.

> *Defects in design that impair utility such as poor layout, tight height and bay clearances can create functional obsolescence.*

3. External Obsolescence, also referred to as "Economic" obsolescence, is a change in the market value of a structure due to changes unrelated to the structure itself. These forces most often have negative effects but can also be an enhancement in value. Impacts may vary based on the type of property — commercial vs. residential. While these external factors exert a significant force on the market demand and willingness-to-pay for a structure, it does not impact the value of the building component resources of labor and material and therefore is not applicable in terms of evaluating depreciated replacement value in relation to flood damage analysis.

> *A manufacturing plant located close to a railroad spur would be considered desirable or advantageous while a residential property located near the same railroad would be a detriment.*

Advantages

The depreciated replacement value provides a direct measure of the value of physical resources subject to flood damage. Local cost multipliers are available that reflect both labor and material and construction practice variations. Adjustment factors provide a price level adjustment based on labor and material costs similar to those required for repair of flood damage.

Disadvantages

The data required to perform a detailed assessment of depreciated replacement value would require entering each structure to determine the condition of the structure and the extent of improvements. Such a level of detail is beyond the resources available for most studies. The use of windshield data collection limits the quantification of basement finishes and certain forms of depreciation. Accordingly, costs estimated from windshield survey may include a relatively high level of uncertainty.

Market Value

Description

Market value, in its purest sense, is the average cash or other value of compensation of an infinite number of identical property interests which were sold at the same effective date in a freely competitive market. However, this is not a realistically attainable concept. Therefore, fair market value is often utilized interchangeably with market value. Fair market value is the property's most probable price in a competitive and open market under all conditions requisite to a fair sale. In a fair market, the price shall not be affected by undue stimulus and the buyer and seller shall each be well informed, well advised, and acting prudently. In addition, the following are necessary for a fair market:

- Motivation to sell and buy;
- Market value is generally value in exchange to persons;
- Reasonable time allowed for exposure in open market;
- Price represents normal consideration for property sold, unaffected by special concessions or creative financing; and
- Value exists because of the market's willingness to pay.

Market value data is readily available as a matter of public record, as these values are recorded for liens and establishing mortgages and deeds. Market value is also reflected in recent sales prices which may possibly be obtained from realtors willing to share their knowledge of recent sales and asking prices of prop-

When an appraiser determines market value, the market data are primary, no matter which other approach may be used for confirmation and support of the findings.

Advantages

Market data often provide an inexpensive and expedient means of obtaining structure value, since there is typically information readily available from assessors, realtors, etc. Market data also directly reflect the specific construction practices and cost variations for the study location.

In estimating structure-to-content ratios, market value has been shown to be a significant predictive variable, particularly when combined with the structure size. The use of market data is also consistent with the NED cost definition of structure value which would be used in evaluating the costs of buyouts or acquisition.

Disadvantages

Although market value is easily accessible, it may be difficult to equate to physical damages, since market value is sensitive to interest rate fluctuations, temporary local economic conditions, environmental contamination, and other issues unrelated to the value of the component resources. Therefore, the market value may not be a true indicator of potential flood damages since factors external to the structure may be accounted for in the value. Since flood damage studies are often precipitated by the occurrence of a catastrophic flood, it is not uncommon that regional economic impacts, such as loss of income and business closures, may severely depress the local economy. Such an occurrence may disturb the balance of supply and demand in the real estate market, temporarily depressing sale prices.

Another difficulty with market value resides in the extraction of land value from the total value when the structure (identified as improvement) value has not been determined separately. Additionally, for structures such as churches and schools, there are often no comparable property sales upon which to base a market value.

Income Capitalization

Description

The income capitalization approach to structure value gives consideration to the monetary sum which a purchaser would be justified in paying for a property for investment. It identifies the value determined by capitalization of the expected net future income that a property is capable of producing, accounting for comparable rentals and normal expenses. When this method is used, the market must be studied to determine fair yield rates, fair rents and expenses, and remaining life expectancy. This approach, in effect, is actually subsidiary to the market value approach.

$$\frac{\textit{Net Operating Income}}{\textit{Rate of Return}} = \textit{PropertyValue}$$

Net operating income is gross operating income (rents, etc.) less all normal expenses associated with operating and maintaining the property. Normal expenses include management fees, taxes, insurance, and structural and exterior maintenance and repairs. Since the gross rentals should equate directly to the fluctuations in expenses, the current charges are applicable over the remaining useful economic life of the property. A normal vacancy allowance is applied to the property to account for the vacancies over the useful life of the property. This allowance is a reduction in the gross rentals that results in an effective gross income.

The net rental is a result of the reduction of gross rentals by the vacancy allowance and normal expenses. The value of the property is estimated by dividing this net rental by the capitalization rate. The market, through the relationship between property sales and resulting net rentals, may be used to determine the capitalization rate.

Advantages

The income capitalization approach furnishes an expedient means of determining structure value, since part of the necessary information, rents and income, may be available even for businesses for which there are no comparable sales data.

Income capitalization may also provide a relatively accurate indicator of the business content value, since the approach takes the level of profit, and theoretically sales, into account.

Disadvantages

Physical damages are difficult to compare to the income capitalization value since the income potential of many properties is primarily a function of location. With income capitalization, it is therefore difficult to extract land value from the total value.

Summary of Valuation Applications

Determination of structure values can theoretically be completed by any of the five methods discussed. Each method has its benefits and disadvantages in relation to how the calculated value represents estimated flood damages. A summary of the advantages of each method for use in predicting flood damage is presented in Table 1. Current COE guidance requires the use of depreciated replacement value as the only proper indicator of the value of resources subject to flood damage. As always, a high priority is placed on the efficient use of resources, and any valuation technique which accurately estimates depreciated replacement value is acceptable.

Table 1 - Objectives and Methods for Determining Structure Value

Suitability for Application to Flood Damage Estimates	Valuation Methods: Reproduction Costs	Replacement Value	Depreciated Replacement Value	Market Value	Income Capitalization
Not Overly Sensitive to Interest Rate Fluctuations	✓	✓	✓		
Sensitive to Location/Local Construction Practice		✓	✓	✓	
Not Sensitive to Local Cost Variations	✓	✓	✓	✓	
Accurate Measure of Long Term Value			✓		
Not Overly Sensitive to Temporary Economic Conditions	✓	✓	✓		
Cost Effective to Collect Information				✓	✓
Available From Existing Sources				✓	✓
Ability to Update The Damage Estimate		✓	✓		
Consistent With Generalized Damage Functions			✓		
Comparable To The Measure of Physical Damage	✓		✓		
Comparable To The Measure of Content Damage		✓	✓	✓	✓
Explicitly Excludes Land Values	✓	✓	✓		
Suitable for NED Analysis of Buyout or Acquisition Costs				✓	

Chapter 3 Practical Applications

General

By examining the practical applications of the methods of estimating structure value, it is possible to determine which method is best suited for an analysis. Before examining possible techniques, this chapter will review some of the current methods being employed by several of the Corps Districts. Once these current methods are reviewed, the remainder of this chapter will be focused on the techniques of depreciated replacement cost, market data and tax assessment. Discussed in this section are the positive and negative aspects of each method for flood damage analysis, primary sources of data, and general techniques to perform the analysis.

Synopsis of Current Practice

Current guidance states that depreciated replacement value is the proper and acceptable structure value indicator for flood damage analysis. Various valuation approaches, however, have been commonly used by different COE field offices. Ten districts were sampled in order to determine how different offices are currently using structure value to estimate flood damage. The survey attempted to determine specific techniques used to determine structure value, as well as information regarding the derivation of depth damage functions and the quantification of uncertainty. Survey responses are presented in Appendix A.

As indicated in Table 2, the surveyed districts predominately use either depreciated replacement cost or market data to estimate structure value. Where market data are used, they are often verified using replacement cost less depreciation. Sources of market data were identified as:

- Appraisal by Real Estate Division;
- Tax Records; and
- Realtors.

Where depreciated replacement costs are calculated, every district surveyed referenced Marshall & Swift as the analysis method. Sources of structure data include:

- Field Inspection; and
- Tax Records.

The majority of surveyed districts apply FIA damage curves to the structure value, reinforcing the need for compatibility between the structure valuation for damage analysis and actual cash values which are the value basis of the FIA damage data.

Table 2 - Summary of Current Practice

District	Valuation Technique		Verification	
	Method	Data Source	Method	Data Source
Baltimore	DRC, M&S	Field Judgment	NA	NA
Galveston	DRC, M&S	Field Judgment	Market Data	Realtors
Los Angeles	DRC, M&S	Tax Data and Field Judgment	NA	NA
Louisville	DRC, M&S	Field Judgment	NA	NA
Mobile	Market Data	Real Estate Appraisers	DRC, M&S	Field Judgment
New Orleans	DRC, M&S	Field Judgment	NA	NA
Rock Island	Market Data	Real Estate Appraisers	None	NA
Saint Louis	Market Data	Tax Records	DRC, M&S or Boeckh	Field Judgment
San Francisco	Market Data	Tax Records	DRC, M&S	Field Judgment
Vicksburg	Market Data	Real Estate Appraisers	None	NA

NOTE: DRC = Depreciated Replacement Cost
M&S = Marshall & Swift Evaluation Service

The survey also indicates a need to develop quantification procedures or general guidelines regarding the uncertainty in structure value estimates.

Techniques for Estimating Structure Value

As was observed through the survey of the sample COE districts, more than one method of structure valuation and verification is currently being utilized. However, the techniques typically employed to estimate or verify structure value include: tax assessment, market data and depreciated replacement. The remainder of this chapter will present the general techniques and sources of data relevant to each of these methods.

Depreciated Replacement Cost

When using replacement cost less depreciation to arrive at an accurate "Depreciated Replacement Value" for a structure, it is necessary to understand all the variables which make up the replacement cost and take into consideration factors which affect depreciation.

Many sources of replacement cost data are available, requiring different levels of detail in the structure description for their application. Each of the following products may be applicable to the analysis of depreciated replacement costs.

E.H. Boeckh, New Berlin, Wisconsin publishes cost data for residential, commercial, industrial, institutional, agricultural, and mobile-manufactured buildings. The data is used for insurance policy placement and underwriting purposes, appraisals and assessments, and claims estimation and settlement. Products include:

- *Building Cost Guides for Residential; Commercial, Institutional, Light Industrial; Agricultural; High-Valued Dwelling; and Mobile-Manufactured Housing (each a separate document published annually)*
- *Select High-Valued Dwelling Replacement Cost Estimator (including software updated semiannually)*
- *Residential Building Valuation System II (RBVS II) - software package (updated quarterly)*
- *Commercial Building Valuation System II (CBVS II) - software package (updated quarterly)*
- *Check Residential or Commercial (abbreviated software package updated semiannually)*
- *Building Valuation Manual (includes all structure types, updated quarterly)*

Marshall & Swift, Los Angeles, California publishes cost data for residential (including manufactured housing), commercial (including institutional) and industrial, small business, and agricultural. The data is used as a guide for determining replacement costs, depreciated values, and insurable values of buildings and other improvements. Products available include:

- *Residential Cost Handbook (updated quarterly)*
- *High Value Section (updated quarterly)*
- *Residential Estimator Software Program (updated quarterly)*
- *Business Valuation Handbook*
- *Handbook of Small Business Valuation Formulas and Rules of Thumb*
- *Commercial Estimator Software Program (updated quarterly)*
- *Marshall Valuation Service (includes all structure types, updated quarterly)*

R.S. Means Company, Kingston, Massachusetts publishes cost data for residential and commercial, industrial, and institutional. The data is available for unit costs for detailed estimating of replacement costs or square foot costs for rapid estimating of replacement costs. Products available include:

- *Square Foot Costs (updated annually)*
- *Residential Cost Data (updated annually)*
- *Building Construction Cost Data (updated annually)*
- *Light Commercial Cost Data (updated annually)*
- *Data for Lotus - software package*

Based on the sample survey of districts, the depreciated replacement cost method of choice is based on the Marshall & Swift construction cost model. Some districts have incorporated this data into damage analysis spreadsheets. In general, this procedure integrates:

- The size of the structure, measured in square feet;
- The unit construction cost of the structure, measured in cost per square foot; and
- An allowance for deterioration, measured as a percent of total value.

Size x Unit Construction Cost x (1 − % Depreciation) = Depreciated Replacement Cost

While numerous refinements and add-ons are possible, these three factors are the heart of the replacement cost less depreciation analysis.

The initial input and basis of the analysis is the size of the building being evaluated. This data can be obtained from tax records, field measurements or topographic mapping, followed up by field inspection. Because this last method relies on a vertical projection of the building on a map, it is necessary to follow up with a field inspection to obtain the number of stories to determine total area and to account for large decks and roof overhangs that could be misinterpreted from the topographic mapping.

Once the size of the building is established, the next step is to develop a unit cost to be applied to the building. In developing unit cost, the first major issue is to stratify the buildings by Class or type of building. Marshall & Swift (M&S) divides all buildings into five basic cost groups by type of framing (supporting columns and beams) walls, floors and roof structures, and fireproofing. In each class, there may be variations, combinations and sub-classes, but, for the purposes of pricing, the major building elements must be considered. Some buildings may be hybrids or combinations so replacement costs may fall between two classes.

While the class of construction helps define costs of framing and exterior walls, building occupancy or use defines many functional characteristics such as load-bearing requirements, number of partition walls

and the extent and type of finishes. Such differences are evident between the value of an open, spartan look of a parts warehouse and a similar sized office building with partition walls, finished ceilings and carpeted floors.

Associated with both the class and occupancy is the Quality of a structure. M&S, for example, uses subdivisions (levels) of quality to scale all buildings and their parts. The groupings of low, average, good and excellent must be understood in an overall context, not just relative to the group of structures being evaluated. In judging quality of a structure, it is suggested to consider the quality of materials, the level of ornamentation and workmanship, and the quantity of various components relative to a typical structure in that class and occupancy.

Once the basic information describing a structure (such as type, class, quality, size, etc.) is collected, any of the various valuation references may be used to estimate replacement costs.

As an example, M&S provides a technique based on square foot or cubic foot costs. This method requires the basic information describing the structure and allows for size and height refinements. The final square foot costs can be further adjusted based on a "local multiplier" and a "current cost multiplier." Lump sum costs are then added in and a depreciation percentage is applied. E.H Boeckh also provides a technique based on square foot costs which requires the basic information describing the structure and allows for size refinements. The final square foot costs can be further adjusted based on a "local multiplier" and a "current cost multiplier". Numerous "added features" such as basements, porches, fireplaces, garages, room additions, etc., are accounted for before a depreciation percentage is applied.

Another example of a simplified and quick technique would be the use of "Means Square Foot Costs" manual to establish a value. This manual provides a square foot cost determined by the basic description of the structure. Adjustments can be made to the square foot cost to allow for variations from the base model such as the addition of a porch or an unfinished basement. In addition, lump sum amounts can be added to account for modifications to the base model such as an additional bathroom or a detached garage.

E.H. Boeckh offers a simple and quick method of developing replacement cost, referred to as the unit count method. The estimates are based on the number of rooms and other features with minimum data including location and class of construction.

M&S and Means both have segregated cost methods which allow for a more detailed breakdown of individual building components. These detailed methods, however, are commonly limited to cost estimating or budgeting applications due to the high cost of data collection.

Once the size and replacement cost is established, the next step is to evaluate the amount of depreciation that has taken place. Depreciation, like structure value, can also be analyzed through a detailed breakdown of physical, functional and external indicators. When considering the extent of physical deterioration, particular attention should be paid to the following general categories: floors and floor coverings, interior construction, mechanical equipment, roof and the exterior walls. The most important

factors impacting physical depreciation are the extent of regular maintenance and capital improvements. The presence or absence of such efforts may halt or accelerate normal depreciation.

Functional obsolescence resulting in depreciation is not always as obvious as the physical indicators, but can also reduce the value of a structure. A variety of negative design characteristics, a poor physical layout, inadequate mechanical equipment or systems and site issues all affect the structure and its setting. Some of the factors affecting the extent of functional obsolescence are code requirements, fire protection requirements or handicapped access requirements. When using depreciated replacement costs to predict flood damage, functional depreciation is relevant to the extent that the unit replacement cost incorporates betterments to the structure considered. In residential structures, for example, the unit cost may incorporate a higher level of electric service than what is provided in an existing structure. The difference in value associated with this condition is considered as part of the functional depreciation.

The final element of depreciation, often overlooked because it is very subjective and difficult to evaluate, is the external obsolescence. When considering the extent of external obsolescence, it is necessary to pay particular attention to the indicators in the immediate vicinity, market area or community as a whole. The physical factors, such as location, along with issues related to the infrastructure and the economics of the area, all contribute to this type of depreciation. Structure values for use in flood damage prediction, however, should not incorporate external depreciation into the analysis. Such factors are market driven and do not impact the value of the structure's component physical resources.

After establishing both replacement cost and depreciation, the depreciated replacement value is calculated as replacement cost less depreciation. This method is subject to numerous judgments and uncertainties which significantly impact results. This uncertainty is demonstrated in examples presented in Tables 3 and 4 which present the impacts on structure value for residential and business, respectively, due to variations in the valuation parameters. These tables provide guidance on where to concentrate field data collection efforts. Table 3 indicates that, for residential structures, the most important factors influencing structure value are the construction quality, building size, effective age and the use of any basement area. Less critical residential valuation factors are the class of construction (masonry vs. wood frame), structural shape or the number and type of garages.

As seen in Table 4, similarly to residential structure values, business structure values are also strongly influenced by the construction quality, building size, effective age and type of basement. Unlike residential structures, however, the depreciated replacement cost of business structures is strongly influenced by the class of construction, i.e., masonry vs. reinforced concrete, and the building occupancy. Variations in building perimeter or the height per story are far less significant valuation factors in the determination of structure value.

Several of the most critical factors to both residential and business structure value determination, such as construction quality and basement use, are difficult to establish during a windshield survey. The accuracy of the structure values may often be improved by conducting a limited detailed survey prior to initiating the windshield survey. This limited detailed survey can identify conditions of structures in the study area.

Table 3 - Measurement Uncertainty Using Depreciated Replacement Costs for Residential Structures

When using depreciated replacement cost techniques, there are certain unknowns and measurement uncertainties which affect the accuracy of the calculated value. Based on field inspection, the value of a house may be estimated as follows:

The structure considered is a two-story, 75 year old, wood frame structure. The following attributes apply to the structure:

- Class - D (Combustible construction, wood or steel frame)
- Quality - Average (Siding, some trim, good asphalt shingles)
- Size - 1,200 sf Total
- Shape - 'L' Shape
- Effective Age - 25 Years
- Basement - Unfinished
- Add-ons - Detached, One-Car Garage (200 sf)
  Front Porch (188 sf)

Considering these factors, the base unit cost (cost per square foot excluding adjustments) is $42.03 with a depreciated replacement cost of $51,971.

Given uncertainties in the measurement process, however, any or all of the significant measurement parameters may be in error. The following sensitivity table presents the impact of possible errors for each parameter.

Valuation Parameter		Base Unit Cost	Structure Value	Percent Change: Base Unit Cost	Percent Change: Structure Value
Class	C (Masonry construction)	$45.49	$53,728	+8.2%	+3.4%
	D W/Veneer	$46.25	$54,635	+10.0%	+5.1%
Quality	Low	$33.17	$42,135	-21.1%	-18.9%
	Good	$58.56	$69,961	+39.3%	+34.6%
Size	1000 sf	$42.03	$44,977	NA	-13.5%
	1500 sf	$42.03	$62,337	NA	+19.9%
Shape	Square	$42.03	$50,061	NA	-3.7%
Effective Age	40 year	$42.03	$32,258	NA	-37.9%
	15 year	$42.03	$59,498	NA	+14.5%
Basement	None	$0.00	$46,559	-100%	-10.4%
	Finished *	$47.63	$70,772	+348%	+36.2%
Add-ons/ Allowances	None *	$0.00	$48,581	-100%	-6.5%
	2-Car Garage *	$15.50	$51,150	-24.2%	-1.6%
	Attached Garage *	$24.30	$51,881	NA	-0.2%

* Unit costs are related to valuation parameter only, not structure base unit cost.

Note: Based on Marshall & Swift, Marshall Valuation Service.

Table 4 - Measurement Uncertainty Using Depreciated Replacement Costs for Business Structures

When using depreciated replacement cost techniques, there are certain unknowns and measurement uncertainties which affect the accuracy of the calculated value. A sample business is estimated as follows:

The structure considered is a one-story, 30 year old, one story, masonry structure. The following attributes apply to the structure:

- Class - C (Masonry construction)
- Quality - Average (Brick, plain front, some ornamentation)
- Size - 2,400 sf Total
- Avg. Perimeter - 200 lf
- Height per Story - 12 ft
- Effective Age - 25 Years
- Basement - Storage

Considering these factors, the base unit cost (cost per square foot excluding adjustments) is $39.68 with a depreciated replacement cost of $115,133.

Given uncertainties in the measurement process, however, any or all of the significant measurement parameters may be in error. The following sensitivity table presents the impact of possible errors for each parameter.

Valuation Parameter		Base Unit Cost	Structure Value	Percent Change: Base Unit Cost	Percent Change: Structure Value
Class	D (Wood or Steel frame) B (Reinforced Concrete w/ brick)	$37.25 $48.48	$93,708 $149,166	-6.1% +22.2%	-18.6% +29.6%
Quality	Low Good	$28.87 $51.61	$79,029 $156,366	-27.2% +30.1%	-31.4% +35.8%
Size	2000 sf 2800 sf	$39.68 $39.68	$97,833 $196,196	NA NA	-15.0% +14.2%
Perimeter	196 lf 248 lf	$39.68 $39.68	$114,040 $123,896	NA NA	-0.2% +7.6%
Height per Story	10 ft 14 ft	$39.68 $39.68	$110,196 $119,973	NA NA	-4.3% +4.2%
Effective Age	40 year 15 year	$39.68 $39.68	$48,115 $147,782	NA NA	-58.2% +28.4%
Basement	None Display	$*0.00 $29.53	$81,622 $142,388	-100% +81.3%	-29.1% +23.7%

* Unit costs are related to valuation parameter only, not structure base unit cost.

Note: Based on Marshall & Swift, Marshall Valuation Service.

Table 4 Measurement Uncertainty Using Depreciated Replacement Costs for Business Structures (continued)

Aside from the impact of errors for the parameters already presented, another parameter of potential concern is ***occupancy***. Aside from the type of business evaluated, occupancy also relates to whether the business is evaluated as a stand-alone building versus one business in a shopping center. However, unlike many of the other parameters presented, occupancy in relation to individual or group consideration impacts several evaluation factors including 1) floor area-perimeter multiplier; 2) base square foot cost; 3) estimated life expectancy; and 4) depreciation. The result of these impacts acting alone or grouped are as follows:

Variation From 2,400 sf Retail As Individual Structure To Part Of Shopping Center

	Valuation Parameter	Base Unit Cost	Structure Value	Percent Change*	
				Base Unit Cost	Structure Value
2,400 sf Retail As Part Of 12,000 sf Neighborhood Shopping Center					
Impact Factor	Base Square Foot Cost	$42.38	$120,696	+6.8%	+4.8%
	Area-Perim. & Base SF	$42.38	$101,272	+6.8%	-12.0%
	Base SF & Depreciation	$42.38	$102,682	+6.8%	-10.8%
	Area-Perim, Base SF, & Deprec	$42.38	$86,157	+6.8%	-25.2%
2,400 sf Retail As Part Of 12,000 sf Community Shopping Center					
Impact Factor	Base Square Foot Cost	$44.97	$126,019	+13.3%	+9.5%
	Area-Perim. & Base SF	$44.97	$105,742	+13.3%	-8.2%
	Base SF & Depreciation	$44.97	$126,019	+13.3%	+9.5%
	Area-Perim, Base SF, & Deprec	$44.97	$105,742	+13.3%	-8.2%
2,400 sf Retail As Part Of 12,000 sf Regional Shopping Center					
Impact Factor	Base Square Foot Cost	$48.99	$134,300	+23.5%	+16.6%
	Area-Perim. & Base SF	$48.99	$112,689	+23.5%	-2.1%
	Base SF & Depreciation	$48.99	$150,336	+23.5%	+30.6%
	Area-Perim, Base SF, & Deprec	$48.99	$126,144	+23.5%	+9.6%

Note: Based on Marshall & Swift, Marshall Valuation Service.
*Percent Change from free-standing retail at $39.68 base unit cost and $115,133 structure value

The techniques and general information presented in this section are incorporated into Chapter 4 in the presentation and explanation of the sample procedural guidelines recommended to be utilized in estimating structure value.

Market Data

In addition to the depreciated replacement cost technique, the market data technique is frequently utilized in determining structure value. The market price of the structure itself or a comparable structure with similar characteristics is utilized to determine the structure value. The value of this comparable structure may need to be adjusted if data are not current, the comparable characteristic has different attributes than those of the structure in question, or there is an insufficient quantity of comparable properties to represent a solid comparative value range. Adjustments may include the following: effective age, condition, obsolescence, quality of construction, time, and other adjustments. Adjustments need not be verified for each of the individual comparables, but rather on the overall trend resulting from all of the comparables combined. Although these adjustments cannot account for every variance, they provide a meaningful indication of the structure value.

Where market data are used to establish structure value, the survey of sample districts indicates that the work is most commonly performed by licensed appraisers within the real estate division. In lieu of such detailed analyses, market data can be obtained from the following sources:

- Surveys and Interviews: Market value can be obtained through interviews of knowledgeable homeowners. It may be difficult, however, to obtain a structure value separate from the land value.

- Recent Sales Prices: Records are kept in most community assessor's office pertaining to the property sales that occur in that community. As a matter of public record, these values are recorded for liens and establishing mortgages and deeds. Recent sales prices can also be obtained from realtors willing to share their knowledge of recent sales and asking prices of properties that are currently on the market. Once again, it may be difficult to separate the structure value from land value. One alternative for making this separation is to obtain recent sale prices of comparable vacant land and reducing the sale price of improved property by this amount, adjusting as necessary for the value of site improvements such as roads and utilities.

Market data are often utilized by COE districts to estimate or verify structure value since it is typically a relatively expedient means of obtaining results, especially when there are little to no adjustment factors required. Chapter 4 presents a sample procedural guideline for estimating structure value.

Tax Assessments

Another frequent means of determining structure value is through the use of tax assessment records. Similar to other methods of estimating structure value, the assessments from tax records need to be examined for several key factors which impact the structure value such as date of the assessment and market

equalization ratios. Oftentimes, tax records are several years old and may have only been updated by inflation factors or only updated for a portion of the properties, thus verification of the ratio of assessed value to market value needs to be established. In addition, California's Proposition 13 limits increased assessments until a home is sold, which results in unequal valuations of one home relative to another. Once consistent ratios are established, structure value estimates can be obtained from the assessments, the assessment-to-value ratios, and the structure-to-land ratios.

One of the difficulties, however, of utilizing tax assessments for estimating structure value is that the ratio applied to equate the assessment value to market value is applied to the total assessed value. There typically is not a differentiation in application of the ratio between land and structure, since, for the purpose of the tax and real estate assessors, these would not be sold separately. The property is considered only on the whole value. However, in reality, the structure and land values may equalize differently since the structure value is primarily cost driven whereas the land value is essentially market driven. Therefore, unless the assessment is recent and reflects the current real estate market, the extraction of land value from the assessed value may not result in an accurate estimation of structure value.

One of the benefits of utilizing tax assessment records, however, is that the information is readily available. Aside from using the assessed value to approximate structure value, the tax assessment records provide an effective means of collecting information required for other valuation methods. Although the type and amount of information contained in the assessments varies, more recent assessments typically include: date of construction; structure dimensions; square footage of living area; attached structures; basement status - finished, unfinished; number of stories; and oftentimes an effective age, percent good, or quality rating of the structure. Some districts have established compatible links to such computerized data, providing an extremely high level of accuracy to depreciated replacement cost calculations. Field inspections, however, are still required to provide supplemental information including data for tax exempt structures.

Chapter 4 incorporates this general information in the presentation of sample procedural guidelines to follow for estimating structure value.

Chapter 4
Sample Procedures

General

The preceding sections have presented a general background of techniques involved in estimating structure value for use in predicting flood damage. To help ensure consistency and accuracy of results, however, structure values for any study should be determined using uniform methods and assumptions. This section presents sample procedural guidelines to be utilized to estimate structure value. Explanations of field data collection procedures and important analysis considerations are identified. Prior to adapting structure valuation guidelines for a particular project, however, a brief site inspection is useful to identify specific concerns that need to be addressed in the procedure application.

In order to provide sample guidelines useful over a range of studies, information is presented on the use of:

- Depreciated Replacement Cost (Construction Cost Models);
- Market Data; and
- Tax Assessments.

To correctly estimate the depreciated replacement value of a variety of structures, the guidelines are further subset into two levels of detail appropriate for use with different levels of study budget. It must be noted that depreciated replacement value is the standard that must be used for flood damage analysis and that the second two methods are merely an alternative means of estimating that resource.

Depreciated Replacement Cost

The analysis of depreciated replacement cost requires two distinct steps. The first step, calculation of replacement cost, evaluates the construction cost of replacing the structure. The second, more subjective step, is to determine the appropriate level of depreciation.

Replacement Cost Analysis

The determination of replacement costs requires collection of specified information regarding the structure. This information may be determined through field assessments at either a windshield (exterior) or detailed (including interior) level of study. Generally, detailed procedures are only applicable to limited sample analyses used to verify other procedures. Tables 5 & 6 provide a summary of significant parameters in the determination of replacement costs including guidelines for addressing expected problems in application for both windshield and detailed evaluations, respectively. The guidelines presented are considered compatible with the Marshall and Swift (M&S) construction cost model, in some cases clarifying or simplifying the M&S procedures. The guidelines are intended to supplement, not replace, the procedures and explanations contained in a selected reference source. Table 6 presents guidelines recommended when

Table 5 - Sample Guidelines for Windshield Survey Procedures

RESIDENTIAL

Occupancy - Based on visual inspection, occupancy refers to whether the structure is a single-family, two-family, or multi-family dwelling. Multi-family dwellings are further subdivided into apartment, hotel, dormitories, assisted living housing, group care homes, clubs, etc. Basements should be considered separately from the rest of the structure. The type of occupancy impacts the assumptions of the interior of the structure which ultimately is reflected in the unit costs because of structural modifications to accommodate multiple units.

Building Size - As one of the key indicators of replacement value, the building size may be obtained from aerial surveys or tax assessment records. The building size must be indicated as the entire structure not solely the size of a residence within the structure. Therefore, when considering two- and multi-family dwellings, the structure value must be determined for the entire structure, not for each residential unit within the structure. Since the structure is shared by two or more units, there is a shared cost of roofing, exterior materials, and some interior materials which must be taken into account in the unit cost.

Of concern when estimating building size, especially when using aerial photos, is that porches and attached garages are not included in the estimation of the size. These elements are to be accounted for separately under add-ons.

Type/Class of Construction - The structures are subdivided by class of construction (based on visual inspection) which pertains to cost groups based on the type of framing and roofing. Although there will be variations within each class, the major building components should be considered when deciding cost.

BUSINESS

Occupancy - Based on visual inspection, occupancy refers to the type of business: department store, retail, restaurant, etc. The type of occupancy impacts the assumptions of the interior of the structure which ultimately is reflected in the unit costs. Compute varying types of occupancy within the same structure separately; office space and separate retail space within the same structure should be analyzed separately when differentiation is evident. When the building construction does not clearly differentiate different occupancies, the building value is best represented by the predominant occupancy. If a specific occupany is not represented in the construction cost guide, costs should be determined based on occupancies using similar construction.

Building Size - As one of the key indicators of replacement value, the building size may be obtained from topographic survey or tax assessment records. The building size must be indicated as the entire structure not solely the size of an individual unit within the structure. If the structure is shared by two or more units, there is a shared cost of roofing, exterior materials, and some interior materials which must be taken into account in the unit cost. A ratio of the average floor area to the average linear foot of perimeter wall should established to develop a relationship of the various occupancies to the total structure.

Of concern when estimating building size, especially when using topographic photos, is that balconies, porches, walkways, etc. are not included in the estimation of the size. These elements are to be accounted for separately under add-ons.

Type/Class of Construction - The structures are subdivided by class of construction (based on visual inspection) which pertains to cost groups based on the type of framing and roofing. Although there will be variations within each class, the major building components should be considered when deciding cost.

Table 5 (continued)

Single- and Two-family residences are primarily of two construction framing types: masonry or frame, either wood- or steel-stud. These framing elements are represented by a range of unit costs. Classification of the veneers will determine where the structure should be located within the framing cost range. When stucco, brick (or similar element) is utilized as a veneer, a knowledge of local construction techniques will serve to decipher whether the structure framing is wood-frame or masonry.

Multi-family are of five construction framing types: structural steel with masonry, reinforced concrete, masonry or concrete load-bearing walls, wood or steel studs, or metal bents. As with the single-family residences, classification of exterior walls will determine where the structure should be located within the framing cost range.

Quality of Construction - Quality of construction is related to the comparative cost variations within the type/class of structure. Quality of construction is typically based on the average structure for the type/class and then adjusted up or down as necessary. The average quality structure represents the largest group of buildings and are typically designed for maximum economic potential, simple ornamentation and finish, and of good standard code construction. The quality scale ranges from low to excellent quality.

Based on visual inspection, the quality of construction is determined relative to the cheapness or expensiveness of the materials or building components examined, the workmanship level, and the quantity of various components. Factors influencing the relative cost of materials utilized include: method of application, thickness of materials, type of ornamentation, design complexities, and the types of finish observed. Workmanship level should be verified that the level is normal/comparable to the type and grade of materials that were used. If not, the quality should be adjusted accordingly. It is typical for one or two components to have workmanship levels of a quality not compatible

Business structures are typically of five construction framing types: structural steel with masonry, reinforced concrete, masonry or concrete load-bearing walls, wood or steel studs, or metal bents. Classification of exterior walls and roof type will determine where the structure should be located within the framing cost range.

Quality of Construction - Quality of construction is related to the comparative cost variations within the type/class of structure. Quality of construction is typically based on the average structure for the type/class and then adjusted up or down as necessary. The average quality structure represents the largest group of buildings and are typically designed for maximum economic potential, simple ornamentation and finish, and of good standard code construction. The quality scale ranges from low to excellent quality.

Based on visual inspection, the quality of construction is determined relative to the cheapness or expensiveness of the materials or building components examined, the workmanship level, and the quantity of various components. Factors influencing the relative cost of materials utilized include: method of application, thickness of materials, type of ornamentation, design complexities, and the types of finish observed. Workmanship level should be verified that the level is normal/comparable to the type and grade of materials that were used. If not, the quality should be adjusted accordingly. It is typical for one or two components to have workmanship levels of a quality not compatible

Table 5 (continued)

with the materials; this should generally be disregarded. In addition to the quality of the various components, the quantity of the components should be examined for what is typical to its class. Consider the number and quality of components typical to the class. If there are a considerable number of components greater or less than typical, or a considerable number of components of higher or lesser value than the class, the quality should be adjusted up or down accordingly.

Of major concern in determining the quality of construction is determination of the average quality structure. The average structure for the type/class is established on a national level not based on what is average for the region of the study. It is not difficult for the estimated values to become skewed. For example, when estimating value on mainly low cost structures the values are often overclassified whereas when estimating value on better quality structures the analyst may underclassify the value.

Basement Status - Since the occupancy of the basement differs from the rest of the structure, the basement is to be evaluated separately. Since the structure value is determined by visual exterior inspection only, it is often difficult to assess the status of the basement. Therefore, when conducting the windshield survey, it is beneficial to speak with local residents, builders, realtors, etc. to gain a better understanding of what is typical to the study area in regards to basements. Generalizations can be established for the various structure types typical to the area of study. For example: single-story ranch houses may be more likely to have a finished-basement (where allowable) whereas large colonials will typically have an unfinished basement (where allowable). Unit costs should be developed for finished and unfinished basements and applied as determined appropriate based on the generalizations established.

Number of Stories - The number of stories in residential structures has a slight impact on the cost. If

with the materials; this should generally be disregarded. In addition the quality of the various components, the quantity of the components should be examined for what is typical to its class. Consider the number and quality of components typical to the class. If there are a considerable number of components greater or less than typical, or a considerable number of components of higher or lesser value than the class, the quality should be adjusted up or down accordingly.

Basement and Mezzanine Status - Since the occupancy of basements and mezzanines differ from the rest of the structure, they should be evaluated separately. Since the structure value is determined by visual exterior inspection only, it is often difficult to assess the status of the basement or mezzanine. Therefore, when conducting the windshield survey, it is beneficial to speak with local businessmen, builders, realtors, etc. to gain a better understanding of what is typical to the study area in regards to these elements of construction. Generalizations can be established for the various structure types typical to the area of study. Unit costs should be developed for display basements, storage basements, and parking basements and applied as determined appropriate based on the generalizations established. In addition, unit costs should be developed for display mezzanines, office mezzanines, and storage mezzanines and applied as determined based on the generalizations established.

Number of Stories - The number of stories will impact the cost, particularly in high-rise buildings where

Table 5 (continued)

the structure has more than one story, reducing the unit cost by 4% then appling that cost to the total area of the building (all floors included) will provide a reasonable estimate of the total cost.

Add-ons - Included within the add-ons are such elements as porches, garages, carports, etc. As with the basements, since these structures are of a different occupancy type than the main structure they are to be considered separately.

Garages should be evaluated similarly to the residential structure by examining the style/class or quality with unit costs associated with the various sub-divisions. Separate unit costs should be available for the sub-divisions for various ranges of garage sizes.

Porches should be estimated as a percentage of the residential square footage cost based on the size (small or large) and type of porch based on foundation and roof. Breakdowns should include: slab on grade or raised floor; unceiled shed roof or roof like residence; enclosed or non-enclosed.

additional costs could result due to raising materials, equipment and staff, increase in size of structural framing members, and increase in wages. When evaluating business structures over three stories high, add 0.5% for each story above ground up to 30 stories and 0.4% for each additional story above 30.

Add-ons - Included within the add-ons are such elements as carport canopies, balconies, etc., which are to be accounted for separately. Approximated as a percent of the final base cost, large entrance marquees or carport canopies are generally 20% - 40% of the final base cost and exterior balconies are generally 25% -50% of the final base cost. Additional add-ons such as elevators and sprinklers should be included within the unit costs based on what is typical for the study region. As with basements and mezzanines, it may be necessary to speak with businesses, realtors, etc. to gain a better understanding of what is considered standard construction practice for the region for the various business occupancies to be evaluated.

Table 6 - Sample Guidelines for Detailed Survey Procedures

RESIDENTIAL

Occupancy - The same subdivisions used in the "Windshield Survey" apply to the detailed procedure and assumptions made during an initial inspection can be confirmed through an interview with the building's owner or occupants. The detailed examination is likely to reveal limitations and errors stemming from the windshield survey. As an example, in some cases, a structure which appeared to be a single-family residence from a windshield survey may have been converted to a two-family. This conversion would increase the value due to the addition of bathrooms and a second kitchen. Such variations can be reflected in a risk-based analysis.

Building Size - This is one of the most tangible aspects of a building survey which can be quickly obtained from topographic survey, plot plans or tax assessment records. In a detailed survey, field measurements of the perimeter of a structure can confirm any judgments made in the "Windshield Procedure." The detailed procedure also allows for a measurement of building height which will affect structure value.

BUSINESS

Occupancy - Assumptions initially based on visual inspection can be confirmed through an interview with the building owner or occupants for a detailed survey. Occupancy refers to the type of business: department stores, discount stores, retail, shopping centers, restaurants, markets, etc. Within each occupancy group there may be several subgroups, ie: fast food establishments fall under the restaurant category yet have different average size, seating, and equipment values. Compute varying types of occupancy within the same structure separately; offices and retail within the same structure should be analyzed independently.

Building Size - As one of the key indicators of replacement value, the building size may be obtained from topographic survey, tax assessment records or field measurement. The building size must be indicated as the entire structure not solely the size of an individual unit within the structure. If the structure is shared by two or more units, there is a shared cost of roofing, exterior materials, and some interior materials which must be taken into account in the unit cost. A ratio of the average floor area to the average linear foot of perimeter wall should be established to develop a relationship of the various occupancies to the total structure.

Of concern when estimating building size, especially when using topographic photos, is that balconies, porches, walkways, etc. are not included in the estimation of the size. These elements are to be accounted for separately under add-ons.

In a detailed survey, field measurements of the perimeter of a structure can confirm any judgments made in the "Windshield Procedure." The detailed procedure also allows for a measurement of building height which will affect structure value.

Table 6 (continued)

Type/Class of Construction - The type/class of a structure is determined through four basic construction indicators. The type of framing and roofing, which were used by the windshield procedure, and the type of flooring and walls will define which Type/Class a structure is considered. During the detailed survey, the specific framing and roofing system, which was assumed in the windshield procedure, can be clarified. Based on these four indicators, most structures are grouped into one of five distinct classes:

- Buildings with fireproofed structural steel frames with reinforced concrete or masonry floors and roofs.
- Buildings with reinforced concrete frames and concrete or masonry floors and roofs.
- Buildings with masonry or concrete exterior walls, and wood or steel roof and floor structures, except for concrete slab on grade.
- Buildings generally having wood frame, floor and roof structure. They may have a concrete floor on grade or other substitute materials, but is considered combustible construction. This class includes the pre-engineered pole frame buildings.
- Buildings with frames, roof and walls of incombustible metal. This class incudes the pre-engineered metal buildings.

Quality of Construction - Since the quality of a structure varies based on the quality of its components and the materials used, workmanship and quantity of components, a detailed survey allows for a complete evaluation in this area. While the windshield procedure may give clues to the quality of the shell of the structure, a detailed survey will also provide a full understanding of the interior construction, mechanical and electrical systems.

Type/Class of Construction - The type/class of a structure is determined through four basic construction indicators. The type of framing and roofing, which were used by the windshield procedure, and the type of flooring and walls will define which Type/Class a structure is considered. During the detailed survey, the specific framing and roofing system, which was assumed in the windshield procedure, can be clarified. Based on these four indicators, most structures are grouped into one of five distinct classes:

- Buildings with fireproofed structural steel frames with reinforced concrete or masonry floors and roofs.
- Buildings with reinforced concrete frames and concrete or masonry floors and roofs.
- Buildings with masonry or concrete exterior walls, and wood or steel roof and floor structures, except for concrete slab on grade.
- Buildings generally having wood frame, floor and roof structure. They may have a concrete floor on grade and other substitute materials, but is considered combustible construction. This class includes the pre-engineered pole frame buildings.
- Buildings with frames, roof and walls of incombustible metal. This class incudes the pre-engineered metal buildings.

Quality of Construction - Since the quality of a structure varies based on the quality of its components and the materials used, workmanship and quantity of components, a detailed survey allows for a complete evaluation in this area. While the windshield procedure may give clues to the quality of the shell of the structure, a detailed survey will also provide a full understanding of the interior construction, mechanical and electrical systems.

Table 6 (continued)

	Many occupancy classifications will not have a full range of "quality" of construction. Warehouse or discount type store, for example, due to the nature of their business's would not be located in an "excellent" quality structure.
Basement Status - Using the detailed procedures allows for a more specific breakdown of basement finishes into four type groups. It should be noted that the classification, quality and amenities expected will vary between single-family residences and multiple-family residences or apartments.	***Basement and Mezzanine Status*** - Since the occupancy of basements and mezzanines differ from the rest of the structure, they should be evaluated separately. Unit costs should be developed for display basements, storage basements, and parking basements and applied as determined based on the visual inspection. In addition, unit costs should be developed for display mezzanines, office mezzanines, and storage mezzanines and applied as determined based on the detailed study.
Number of Stories - The same rules used for Windshield Procedures apply to a detailed survey. An in-depth walk-thru will allow the investigator to verify the exact quantity of habitable space. Often a 1½-story residence has rooms within a dormered attic space which may not be apparent from topographic surveys, tax records or visual inspection from the Windshield Procedure.	***Number of Stories*** - The number of stories will impact the cost, particularly in high-rise buildings where additional costs could result due to raising materials, equipment and staff, increase in size of structural framing members, and increase in wages. When evaluating business structures over three stories high, add 0.5% for each story above ground up to 30 stories and 0.4% for each additional story above 30.
Add-ons - The evaluation of various add-ons such as porches, garages and carports is considered separately as they were using the Windshield Procedure. The detailed procedure allows for more careful examination of size, quality, condition and construction techniques which will determine individual square foot costs for each element.	***Add-ons*** - Included within the add-ons are such elements as carport canopies, balconies, etc. should be accounted for separately. Approximated as a percent of the final base cost, large entrance marquees or carport canopies are generally 20% - 40% of the final base cost and exterior balconies are generally 25% -50% of the final base cost. Additional add-ons such as elevators and sprinklers should be included within the unit costs based on actual quantity and type for conveying systems and square footage for sprinkler systems.
Foundations & Substructures - Foundations and substructures unit costs should include such items as excavation, footings, foundations, and other special substructures.	***Foundations & Substructures*** - Foundations and substructures unit costs should include such items as excavation, footings, foundations, and other special substructures.
Framing and Superstructure - Elements to be considered for unit costs include columns and beams,	***Framing and Superstructure*** - Elements to be considered for unit costs include columns and beams,

Table 6 (continued)

elevated floors, structural walls, sheathing, roofs, stairs, etc.	elevated floors, structural walls, sheathing, roofs, stairs, etc.
Exterior Closure - Within exterior closure are such items as exterior wall construction including siding, veneer, insulations, felts, etc. as well as windows, doors, glazed walls and exterior wall finishes for development of unit costs.	***Exterior Closure*** - Within exterior closure are such items as exterior wall construction including siding, veneer, insulations, felts, etc. as well as windows, doors, glazed walls and exterior wall finishes for development of unit costs.
Roofing - Consideration for unit costs should be granted to roof covering materials, insulation, flashings, gutters and downspouts, vapor barriers, openings and other roof specialties.	***Roofing*** - Consideration for unit costs should be granted to roof covering materials, insulation, flashings, gutters and downspouts, vapor barriers, openings and other roof specialties.
Interior Construction - Within interior construction are such elements as partitions, interior doors, wall finishes, ceiling finishes, trim and moldings, etc. for consideration when developing unit costs.	***Interior Construction*** - Within interior construction are such elements as partitions, interior doors, wall finishes, ceiling finishes, trim and moldings, etc. for consideration when developing unit costs.
Mechanical Equipment - Included in unit cost development under mechanical equipment are; plumbing, fire protection, heating and cooling systems, and any other special systems.	***Mechanical Equipment*** - Included in unit cost development under mechanical equipment are; plumbing, fire protection, heating and cooling systems, and any other special systems.
Electrical Equipment - Such items as service and distribution, lighting and power (wiring, fixtures, etc.) and other special electrical items such as alarm systems and emergency lighting should be considered when developing unit costs.	***Electrical Equipment*** - Such items as service and distribution, lighting and power (wiring, fixtures, etc.) and other special electrical items such as alarm systems and emergency lighting should be considered when developing unit costs.
Conveying Systems - Although typically only some multi-family residences will include this section, unit costs should be developed for systems including elevators (or any other conveyance system).	***Conveying Systems*** - Unit costs should be developed for systems including elevators, escalators, and special conveying systems in manufacturing/industrial, factories and warehouses.

an accurate and detailed depreciated replacement cost for a structure is required. This procedure is especially useful when a random sample of structures is being used to adjust other data sources.

When estimating replacement cost for residential or business structures, it is essential to address several items relevant to residential or business construction each of which impacts the replacement cost in a different manner. The elements to be considered include: occupancy, building size, type/class of construction, quality of construction, basement status, number of stories, and add-ons.

The basement types for single-family residences are divided into low cost, semi-finished, game room, and a fully finished basement. The differences in type depend on wall, floor and ceiling finishes, along with the level of electrical, plumbing and heating provided. Costs per square foot can vary greatly between low cost and fully finished and will certainly affect the overall structure value. For multiple-family residences or apartments, the subdivision of basement type for applying M&S is more simplified. The classifications are limited to finished or unfinished, or average basement parking versus low cost parking. The range in square foot costs for these basement types only varies about $5 per square foot; therefore, definition of multi-family basement types is not as critical as defining basements for single-family residences.

Depreciation Analysis

To derive a percent of depreciation, which may be applied to the replacement cost for a structure, it is necessary to define what portion of the structure's life is "used up" and will not contribute to the future worth of the structure. This analysis normally requires defining the **effective age** or **remaining life** of the item. An alternative, more detailed approach to depreciation is to determine the "cost to cure" any accrued deficiencies, including the present worth of any future required expenditures. In determining structure values for use in predicting flood damages, however, the detail and expense of "cost to cure" analyses is unnecessary and unwarranted. The use of standard depreciation tables relating the condition and/or age of a structure to percentage loss of value forms the basis of most depreciation analyses.

Of significant concern in these analyses is the difficulty in defining, much less estimating, effective age. In the 1970s, Federal and state floodplain regulations were put into effect controlling and restricting construction in flood-prone regions. Therefore, when assessing structure value for the purposes of estimating potential damage, the majority of damages will accrue in the structures at least 25 years old. The use of "chronological age" will usually overstate the depreciation of older structures, therefore it is important to consider the impact of maintenance and upgrades on the effective life. Some references, such as M&S, suggest that this problem may be minimized by relating depreciation of an item to its remaining life, a value more directly related to the condition than to the age of the structure. When estimating the condition of a structure from the exterior, the condition classification keys presented in Table 7 may be used as a guide.

The matrix in Table 8 compares conditions of six structure types to a "remaining life" based on the typical expected life for that type of structure. The condition of "new" represents a structure which is newly constructed and has a "remaining life" equal to the average life expectancy of a structure in that

Table 7 - Condition Classification Keys

Condition	Description
New	Representative of a structure which is newly or nearly newly constructed with a remaining life equal to the average life expectancy.
Excellent	Representative of a structure which is of relatively newer construction or containing significant rehabilitation resulting in a remaining life of approximately 90% of the average life expectancy.
Good	Representative of a structure in which no obvious maintenance is required but neither is everything new. The resulting remaining life is approximately 70-75% of the average life expectancy.
Average	Representative of a structure which has some evidence of deferred maintenance and normal obsolescence with age. Few minor repairs and refinishing required. Resulting remaining life is approximately 50-60% of the average life expectancy.
Fair	Representative of a structure with several noticeable immediate needed repairs evident such as peeling paint on siding, damaged roofing, etc. Resulting remaining life is approximately 30-40% of the average life expectancy.
Poor	Representative of a structure with numerous immediate repairs required. Many items need refinishing or overhauling, obvious deferred maintenance and inadequate building utility and services. Resulting remaining life is approximately 15-20% of the average life expectancy.
Dilapidated	Representative of a structure which is generally abandoned or uninhabitable. Although the structure may be intact, there are numerous immediate structural repairs required. Resulting remaining life is assumed to be zero.

Source: Adapted from Marshall & Swift, Marshall Valuation Service (Los Angeles, 1991 with 1994 update), p. Sect. 97, 3.

classification. The condition of "dilapidated," at the other end of the scale, represents a structure which is abandoned or uninhabitable. A remaining life of zero years is assigned to this condition although the building is still intact and has some value. The remaining life estimates in Table 8 represent general guidelines based on judgment and may vary in accordance with the standards of quality for construction in a given area.

After estimating the remaining life of the structure, a reasonable estimate of depreciation is possible. Table 9 compares the remaining life to percentage depreciation for six typical structure types. These percentages, developed by cross referencing effective age, remaining life, and percent depreciation in M&S, can be applied to the replacement cost to yield a "depreciated replacement cost."

Table 8 - Sample Correlation of Condition to Remaining Life

Condition	Typical Remaining Life by Structure Type						
	Single Family Residential	Multi Family	Commercial /Retail	Restaurant	Office	Warehouse/ Industrial	Factory
New	55	60	50	40	55	50	50
Excellent	50	55	45	36.00	50	45	45
Good	40	45	35	28.80	40	35	35
Average	30	35	25	22.00	30	25	25
Fair	20	25	15	14.00	20	15	15
Poor	10	10	10	8.00	10	10	10
Dilapidated	0	0	0	0	0	0	0

Source: Adapted from Marshall & Swift, Marshall Valuation Service (Los Angeles, 1991 with 1994 update), pp. Sect. 97, 3-11.
Note: The remaining life estimates are one of a range of possible values. Best judgment should be used.

Within each structure type category, 0% depreciation is assigned to the remaining life which represents a "new" condition structure or full life expectancy. The table shows the highest percentage of depreciation for structures which would be classified as in "dilapidated" condition.

Using remaining life as effective age of a building can provide an accurate estimate of depreciation within a reasonable level of effort. In some cases, however, detailed inspection indicates that different components of a structure are in vastly different conditions. A structure with a new roof and exterior siding, for example, could have outdated, inadequate electrical and mechanical facilities. Where detailed inspection reveals such divergent conditions, depreciation may be estimated more accurately by considering the condition of each component separately. The overall depreciation of the structure may be evaluated by weighting the level of depreciation for each component by the component's proportion of the structure's total value.

Based on model costs for average quality buildings, typical proportions of total costs for major building components are presented in Table 10.

Table 9 - Sample Correlation of Remaining Life to Depreciation

Remaining Life in Years	Percent Depreciation by Structure Type						
	Single Family Residential	Multi Family	Commercial /Retail	Restaurant	Office	Warehouse/ Industrial	Factory
60	NA	0	NA	NA	NA	NA	NA
55	0	4	NA	NA	0	NA	NA
50	4	8	0	NA	2	0	0
45	9	12	3	NA	4	3	3
40	15	18	6	0	8	6	6
35	21	24	11	5	13	11	11
30	28	31	17	11	19	17	17
25	36	39	25	20	26	25	25
20	45	47	34	30	36	34	34
15	55	55	46	43	46	46	46
10	63	64	59	57	58	59	59
5	71	70	72	70	68	72	72
0	80	80	80	80	80	80	80

NA - Not applicable since remaining life exceeds average life expectancy of structure.

Source: Adapted from Life Expectancy Guidelines and Depreciation Tables: Marshall & Swift, Marshall Valuation Service (Los Angeles, 1991 with 1994 update), pp. Sect. 97, 4-13.

Table 10 - Proportion of Total Cost for Major Building Components

Major Bldg. Components	Percent of Total Cost by Structure Type					
	Residential	Multi Family	Commercial /Retail	Office	Warehouse/Industrial	Factory
Foundations (+ Substructure)	5	6	14	5	26	16
Framing (+ Superstructure)	14	15	8	13	13	12
Exterior Walls	15	13	16	12	12	11
Roofing	6	3	7	3	9	9
Interior Construction	34	27	18	28	8	11
Specialties	2	2	N/A	N/A	4	N/A
Mechanical	17	21	21	21	18	24
Electrical	7	8	16	14	10	17
Conveyors/Elevators	N/A	5	N/A	4	N/A	N/A

Source: Adapted from Marshall & Swift, Marshall Valuation Service (Los Angeles, 1991 with 1994 update).

Table 11 provides a general description of each of these components, including some of the important indicators of depreciation. When evaluating structures with relatively unique needs, such as manufacturing facilities, the analyst should actively seek and rely on information provided by company representatives.

Determination of Uncertainty

Sensitivity calculations presented in Chapter 3 indicate that variation of up to 30% in structure value may not be uncommon. In order to quantify such uncertainty for use in risk-based analyses, an audit or sample comparison of structure values may be used. The analysis of differences in paired values provides a measure of dispersion. Other sources of depreciated replacement cost data, such as recent flood damage adjustment reports, may also be utilized for comparison.

Table 11 - Building Component Evaluation Keys

COMPONENT DESCRIPTION	EVALUATION FACTORS
Foundations & Substructures - This category will include all footings and foundations, piers and caissons, excavation and backfill, slabs on grade and other special substructures.	***Foundations & Substructures*** - Cracks or unevenness in floors, damage at loading dock areas or exposed sections of foundation wall, exposed reinforcing bar at joints or in footings, cracks in slabs at column connections and separation at expansion joints in slabs, damaged insulation or drainage.
Framing & Superstructure - Can include all columns and beams, structural walls, elevated floors, roof, stairs and sheathing.	***Framing & Superstructure*** - Unprotected or deteriorated steel framing, cracks or damaged structural walls and elevated floors, deflection in roofing or floor framing, stairs sagging or decaying.
Exterior Closure - Exterior walls (including all elements of construction such as siding, veneers, building felts, insulation, etc.), windows, doors, glazed walls and exterior wall finishes.	***Exterior Closure*** - Peeling paint, cracked or loose mortar joints, oxidized sheet metal, frame lines out-of-plumb, loose or decaying wood siding, loose ornamentation, brick that needs painting or pointing, inoperable windows or clerestory sashes, broken or rusted screens, sticking doors, inoperable hardware.
Roofing - Roof covering materials, insulation, flashings, gutters and downspouts, vapor barriers, openings and other roof specialties.	***Roofing*** - Evidence of leakage, oxidized roof metal, shingles or tiles missing or split, stained interior ceilings, sagging or decaying roof structure, cracking laminated trusses, tie rods to strengthen bottom chords of timber trusses, damaged truss bracing, plugged roof drains, evidence of standing water, vibration from mechanical equipment, damaged insulation.
Interior Construction - Partitions, interior doors, wall finishes, floor finishes, ceiling finishes, trim and moldings and the interior surface of the exterior walls.	***Interior Construction*** - Cracks in plaster, open joints in millwork, sticking doors, peeling paper or paint, scars, missing or loose hardware, smoke stains, mildew stains or the effect of prolonged dampness, rodent, insect or termite infestation, damage or decay. Evidence of cracks, unevenness, sagging, worn finish, rough or scarred finishes, creaking or springiness underfoot in floors and floor coverings.
Specialties - Kitchen and bathroom cabinets and countertops common in residential structures and miscellaneous items such as loading dock boards and levelers in a commercial buildings like a warehouse.	***Specialties*** - Worn or damaged cabinetry and countertops, loose or missing hardware, damaged, missing or deteriorated loading dock boards, inoperable loading dock levelers.

Table 11 (continued)

Mechanical Equipment - Includes all plumbing (kitchen, bathrooms, service fixtures), fire protection, heating systems (furnaces, hot water heaters), cooling systems and any other special systems.	*Mechanical Equipment* - Inadequate or excess number of poorly spaced or antiquated plumbing fixtures, HVAC and other equipment, worn, broken or stained plumbing fixtures, leaking faucets or piping connections, odors indicative of faulty sewer piping, escaping steam, noisy radiators, rusting pipes, battered or rusted ductwork, furnaces or boilers in poor repair, mold, mildew from defective filters and air cleaners.
Electrical Equipment - Service and distribution, lighting and power including wiring, fixtures, switches and receptacles, other special electrical items, such as alarm systems and emergency lighting.	*Electrical Equipment* - Defective wiring, broken or tarnished light fixtures, loose switches, inadequate or excess number of poorly spaced or antiquated electrical and lighting fixtures, appliances and other equipment, service and power requirements, energy consumption or efficiency, actual vs. rated capacity or performance.
Conveying Systems - This category applies to only some multi-family residential like apartment buildings and commercial structures which include elevators, escalators and special conveying systems in manufacturing, factories and warehouses.	*Conveying Systems* - Inoperable, inadequate or antiquated equipment, lack of handicapped requirements including elevator controls, signage, cab size, lifts, etc.

Market Data

Structure value, as determined by market data, is based on the property's most probable price in a competitive and open market under all conditions requisite to a fair sale. The following information will assist the damage analyst in utilizing the vast base of market data. Market data are often readily available through public record for values recorded for mortgages, liens and deeds or from sales prices obtained from realtors. It is important to remember that although market data are used, the value to be measured is depreciated replacement value. Market data may provide information that is representative of replacement value less depreciation when the following conditions apply:

- data is recent;
- economic depreciation is negligible;
- land and improvement values are separated easily; or
- recent flooding or other event has not caused temporary perturbations to the market (i.e., stable market).

The validity of market data must therefore be established using techniques such as described in Chapter 6 to correlate market value with depreciated replacement value.

Limited Study

The following guidelines are recommended for the market data approach when a limited study is required. This general approach is applicable to areas that are fairly homogeneous in structure type, age, condition, etc. The following steps are integral to the general market data approach when there are limited resources to perform the study:

- Survey the Study Area;
- Stratify Structure Types; and
- Contact Local Realtors or Assessors.

Survey of the Study Area. Perform a general survey to verify that the study area is relatively homogeneous and typical or average structure data can be derived. An area is characterized as relatively homogeneous when the structures are generally of similar age, quality of construction type, style, etc., often constructed by a single builder as part of a development. Determine the structure types located in the study area and identify an average structure size and overall condition for each type. In addition, identify a typical lot size for each of the structure types. Where possible, obtain representative photographs of typical structures.

Stratify Structure Types. Based on the information obtained from the survey of the study area, develop a list of structure types (ex. one-story residential, retail, etc.) typical to the study area. In addition to the structure types, provide a brief description of the typical structure (structure size, age, condition, lot size, etc.) for each type. This information will be used when contacting local realtors or assessors.

Contact Local Realtors, Assessors. Once the structure types have been identified, contact knowledgeable individuals such as realtors, assessors, etc., for information related to the identified structure types. Determine the average cost and range of costs for each of the structure types identified within the study area. Values obtained from the realtors and/or assessors should not include land values. If the structure values cannot be separated from the total cost, land values shall be approximated, based on lot sales for typical lot sizes within the study area. The dispersion of this average structure value should be determined for use in a risk-based analysis. Values should be verified as described in Chapter 6.

Detailed Study

The following procedures should be utilized when detailed studies are being performed. The procedures are similar to that of the limited market data approach, with the exception of the level of detail and the development of guidelines of structure reference (rather than averages) for the detailed approach. The following steps are integral to the market data approach when sufficient resources are available to perform the study:

- Survey of Study Area;
- Identify Structure Types;
- Contact Local Realtors or Assessors; and

- Develop Guidelines of Structure Reference.

Survey of the Study Area. Perform a general survey to obtain general information relative to the study area including typical structure types, the range of remaining life and conditions within each structure type and the typical lot sizes for the range of structure types for each town of the study area. A photo should be obtained for the range of structures, including upper and lower limits, within each of the identified structure types for inclusion in the guidelines of structure reference.

Stratify Structure Types. Based on the information obtained from the survey of the study area, develop a list of structure types (ex. one-story residential with and without basement, retail, etc.) typical to each town within the study area. A further classification such as cape, colonial, etc., further refines the results of the structure value estimate. The identification should include a brief description including a general list of assumptions such as number of stories, bedroom location, and unique characteristics for each structure type along with a few photographs of these typical structure types. In addition, general assumptions related to basements and garages should be identified. This information will be utilized in the formulation of the guidelines of structure reference and when interviewing local realtors and/or assessors.

Interview/Contact Local Realtors, Assessors. Once the structure types have been identified, contact knowledgeable individuals such as realtors, assessors, etc., for information related to the identified structure types and the range within each type. Develop a cost range for each of the structure types for each town in the study area. Keep in mind that differing structure values for affluent towns may account for upgraded construction techniques. Values obtained from the realtors and/or assessors should not include land values. If the structure values cannot be separated from the total cost, land values shall be approximated based on lot sales for typical lot sizes within the town of interest.

Develop Guidelines of Structure Reference. Based on the survey data and information obtained from local realtors and assessors, guidelines of structure reference should be developed to provide consistency and uniformity of structure value estimation. The guidelines are the reference document on which to base all structure value determinations for the study. The guidelines should be organized by town then structure type. Each structure type (within each town) should be subset into several structures representing the range of structures and costs typical to that type. The subset structures should be presented with a photograph of a representative structure and a description including cost and the elements impacting cost. Factors influencing the range in cost include: structure size, roof condition, exterior wall condition and various attributes unique to the structure type. These factors should be briefly discussed in relation to their impact on structure value.

Along with the photo obtained in the field survey, information obtained from realtors' multiple listings may provide good examples of typical structures, their components and price ranges within a town.

Tax Assessments

Use of Tax Assessment

Tax assessments are typically easy to obtain and often can be utilized in estimating structure value. Tax assessment records may provide information that is representative of replacement value less depreciation when the following conditions apply:

- assessment has been performed recently;
- assessment grants consideration to effective age, remaining life, percent good or similar element;
- economic depreciation is negligible; and
- land and improvements are assessed separately.

When any of these conditions do not apply, the tax assessments will not provide an accurate estimation of structure value less depreciation. A deviation from any of these conditions will possibly result in the assessed value being greater or less than the depreciated structure value to be utilized in flood damage analyses. In addition, since the tax assessment equalization factors often vary from community to community, or county to county, it is essential to review what the tax assessments are actually presenting before they may be utilized to estimate structure value. Variations in tax assessment data can be seen in Appendix B, which provides a brief review of some preliminary surveys of data from tax assessor offices.

For the purpose of utilizing tax data as representative of replacement value less depreciation, it is imperative that the assessments be relatively recent. Oftentimes, for tax assessment purposes, the tax assessments often need to be recent enough so that their value represents at least 50%-80% (varies by community, county, or state) of the structure's market value. This frequentlly results in the full tax assessments being up to five, 10 or more years old. Even though structures are routinely updated by an applied factor, of concern here is the time of the last full assessment. Although states identify the relationship between assessed value and market value, the relationship is only applicable to the total assessed value and not to the land and structure separately. Unfortunately, for the sake of structure value estimation, it is not appropriate to apply this factor only to the structure assessment, since the structure assessment and land assessment values may change at dramatically different rates. For example, if the land values have a relatively large increase, applying the "common" update factor to both the land and structure separately will overestimate the structure value. Therefore, only recent assessments which will actually represent the structure value less depreciation should be considered when determining the depreciated replacement value of the structure.

In addition to the age of the assessment, the assessed value must take into account the structure's effective age, remaining life, percent good or similar element since these factors are integral in determining replacement cost less depreciation. Assessments based solely on the actual age of the structure are probably underestimating the structure's value.

Economic depreciation should be determined to be negligible in the tax assessment data when using the data for estimating depreciated replacement value. The value of resources as relevant to flood damage estimation is only concerned with physical and functional depreciation. Economic depreciation does not impact the actual value of the physical structure components and therefore must not significantly impact the assessed value utilized as an indicator of depreciated replacement value. Inclusion of economic depreciation may result in the underestimation of the structure value.

Limited Study

The limited approach duplicates that of the detailed approach in assumptions and in the following steps: survey the area, identify types of structures, contact tax assessor, and perform verification. However, rather than developing an extensive guideline for structure reference for a range of structure values for each structure type, use an average structure value for each structure type within each town. Therefore, only one value need be applied to each structure type rather than analyzing a range of values. The standard deviation of this average value should be determined for use in a risk-based analysis.

Detailed Study

The basis of the detailed approach duplicates that of the market value approach in the following steps: survey the area, identify types of structures, develop guidelines of structure reference, and perform verification. The only steps that vary are that rather than contacting local realtors, the tax assessor's office becomes the source and land values do not need to be removed from the value since tax assessments assess the structure (improvements) and land separately.

Use as Information Source

In addition to utilizing tax assessment records for values that are representative of replacement value less depreciation, the tax data may provide useful information for construction cost models, such as Marshall & Swift, for completing depreciated replacement cost analyses. Based upon information provided by tax assessor offices, obtainable information varies from community to community. Information often available includes: building size, dimensions, stories, construction date (actual age), attachment structures, basement status, and oftentimes depreciation. Although the available information needs to be identified on a town by town basis, the data may provide great assistance in completing the valuation method for depreciated replacement value. The major obstacle to use of tax data is the logistics of linking different local tax files with the database or spreadsheet used to calculate flood damage. This procedure is therefore most applicable to one community or tax jurisdiction.

Oftentimes, the tax record data also includes an effective age or percent good which is beneficial in depreciated replacement value methods. The tax assessment depreciation factor needs to be examined. This factor may be one summary factor, and if so, often includes an economic depreciation which is not relevant to depreciated replacement value. If, however, depreciation is separated into physical, functional, and economic factors, the physical and functional components may be used to calculate depreciated replacement costs.

Chapter 5
Sample Applications

General

This section will document five case studies of actual properties from towns within the Passaic River Basin, New Jersey and illustrate both the windshield and detailed depreciated replacement value method as well as a comparison to market data and tax data. Three non-residential and two residential properties serve as the structures for the case studies. Properties for the case studies were chosen with the aim of varied structure use and configurations to present diverse cost analysis considerations. Differing communities were chosen to reflect variations in tax and market data.

When conducting flood damage studies, it is often desirable to perform a small number of detailed surveys prior to establishing windshield survey guidelines. This limited, detailed survey effort helps to identify local trends regarding basement use and other significant valuation parameters.

Data Collection

As discussed in previous chapters, there are key elements related to the specific building that are necessary to determine the estimated replacement value less depreciation no matter which approach is utilized. These elements include: occupancy, type/classification of construction, quality of construction, number of stories, building size, condition, basements, garage, and add-ons. Beyond these key elements are additional structure characteristics, particularly related to interior construction, which will provide a more detailed determination of replacement value less depreciation.

Depreciated Replacement Cost

Data were collected for the five case studies for the determination of replacement cost through field assessments at both a limited or windshield level and a detailed level of study. As noted previously, the windshield survey is strictly an exterior examination of the structure, whereas the detailed survey involves access to the interior of the structure. The data collected were based on the guidelines established in this document, and in a form compatible with Marshall and Swift, a construction cost model typically utilized by a large number of Corps Districts. The data are summarized in Tables 12 and 13 for the business and residential structures, respectively, for both a windshield and detailed level of study. As evidenced in the tables, the detailed study incorporates a larger pool of information. In addition, there are frequently different assumptions between the windshield and detailed level of study due to the inclusion of interior structure data in the detailed study.

Case Study #1 When performing the windshield survey, the structure was identified as an industrial building and office with the building size estimated at 36,000 sf total based on topographic surveys, with the office estimated at 4,000 sf. The quality and condition of both the industrial building and office were

Table 12 - Depreciated Replacement Data Collection Summary for Businesses Structures Case Studies #1, #2, and #3

CASE STUDY	# 1		# 2		# 3	
Survey Type	Windshield	Detailed	Windshield	Detailed	Windshield	Detailed
Structure	*Business*		*Business*		*Business*	
Location (NJ)	Fairfield		Fairfield		Ramsey	
Occupancy	Industrial/Manuf& Office	Industrial/Manuf& Office	Industrial/ Engineer	Industrial/Flex	Restaurant	Restaurant
Type/ Classification	Struct Steel w/ Masonry (Manuf) Masonry (Office)	Struct Steel w/ Masonry (Manuf) Masonry (Office)	Struct. Steel w/Masonry	Struct. Steel. w/Masonry	Masonry Load Bearing Walls	Masonry Load Bearing Walls
Quality	Avg (Manuf) Avg (Office)	Avg (Manuf) Avg (Office)	Good	Avg	Good	Avg
No. Stories	1 (Manuf) 2 (Office)	1 (Manuf) 2 (Office)	1	1	1	1
Avg. Building Size (sf)	32,000 (Manuf) 4,000 (Office)	31,000 (Manuf) 4,000 (Office)	63,400 (Total) 9,600 (Indiv.)	65,200 (Total) 8,400 (Indiv.)	1,375	1,546
Avg. Perimeter (sf)	820 (Manuf) 240 (Office)	820 (Manuf) 240 (Office)	1,165 (Total) 440 (Indiv.)	820 (Total) 400 (Indiv.)	160	170
Condition	Avg (Manuf) Avg (Office)	Avg (Manuf) Avg (Office)	Good	Good	Good	Good
Refinements	-	-	-	-	Basement	Basement
Foundations & Substructure	-	At Grade, Concrete Block	-	At Grade, Masonry	-	Concrete Block
Framing & Superstructure	-	Concrete at Grade, Steel Joist Roof (Manuf) Concrete at Grade, 2nd Floor Steel Joist, Steel Joist Roof (Office)	-	Concrete at Grade, Steel Joist Roof	-	Bearing Wall, Wood Floor, Wood Joists & Sheathing at Roof

Table 12 (continued)

CASE STUDY	# 1		# 2		# 3	
Survey Type	Windshield	Detailed	Windshield	Detailed	Windshield	Detailed
Exterior Closure	-	8" Concrete Block (Manuf) Brick, Block Backup (Office)	-	12" Block Plus Ornamented Face Block	-	60% Concrete Block W/Siding, 40% Store Front (Above Average)
Roofing	-	Built-up Composition, Flat (Manuf & Office)	-	Built-up Composition, Flat	-	Composition Shingles
Interior Construction	-	Exposed Ceiling, Limited Indust. Partition, No Floor Cover (Manuf) Acoustic Tile, Office Partition, Carpet & Tile (Office)	-	Exposed Ceiling, Average Partition, No Floor Cover	-	Acoustical Tile, Typical Restaurant Partitions, Marble Floor Cover
Specialties	-	Average (Manuf & Office)	-	Average	-	Higher Quality Restaurant, Average
Mechanical Equipment	-	Average (Manuf & Office)	-	Average	-	Higher Quality Restaurant, Average
Electrical Equipment	-	Average (Manuf & Office)	-	Average	-	Higher Quality Restaurant, Above Average
Conveying Systems	-	-	-	-	-	-

Table 13 - Depreciated Replacement Data Collection Summary for Residential Structures Case Studies #4 and #5

CASE STUDY	# 4		# 5	
Survey Type	Windshield	Detailed	Windshield	Detailed
Structure	*Residential*		*Residential*	
Location (NJ)	Pompton Lakes		Pequannock Township	
Occupancy	Single-Family Ranch	Single-Family Ranch	Single-Family Colonial	Single-Family Colonial
Type/ Classification	Wood-Frame	Wood-Frame	Wood-Frame	Wood-Frame
Quality	Good	Avg-Good (Hse) Avg (Basement)	Good (House & Garage)	Good (House & Addition) Fair (Basement)
No. Stories	1	1	2	2
Avg. Building Size (sf)	825	816	1,125 (House) 600 (Garage)	672 (House) 336 (Basement) 486 (Addition)
Avg. Perimeter (sf)	-	83	-	104 (House) 76 (Basement) 90 (Addition)
Condition	Good	Avg (House) Avg (Basement)	Good-Excellent (House & Garage)	Good (House) Avg (Basement) Excellent (Addition)
Refinements	Basement	Basement - 50% Waterproof Only, 50% Framed & Carpeted	Basement, Deck, Fireplace	Garage, Deck, Stairs, Fireplace
Foundations & Substructure	-	Concrete Block	-	Concrete Block (House & Addition)
Framing & Superstructure	-	Bearing Walls, Wood Floor Support, Wood Joists, Wood Deck Roof	-	Bearing Walls, Wood Floor Support, Wood Joists, Wood Deck Roof (House & Addition)
Exterior Closure	-	Vinyl Siding	-	Vinyl Siding (Very Good House & Addition)
Roofing	-	Comp. Shingles, Timber Trusses	-	Composition Shingle (House & Addition)

Table 13 (continued)

CASE STUDY	# 4		# 5	
Survey Type	Windshield	Detailed	Windshield	Detailed
Interior Construction	-	Gypsum Ceiling, Framed Interior, 25% Carpet, 3% Ceramic Tile, 47% Hardwood, 25% Resilient Floor Cover	-	Gypsum Ceiling, Framed Interior (House & Addition) 50% Carpet, 10% Ceramic Tile, 20% Hardwood, 20% Resilient Floor Cover (Avg-House), 100% Carpet (Good-Addition)
Specialties	-	Typical Single Family - Average	-	Typical Single Family - Average
Mechanical Equipment	-	Standard Single Family - Average	-	Standard Single Family - Average
Electrical Equipment	–	Typical Single Family - Average	-	Typical Single Family - Average
Conveying Systems	–	-	-	-

considered to be average. Based on visual inspection and what is considered typical of the area for this structure occupancy, basements and mezzanines were not considered.

The detailed survey also revealed the structure to be an industrial building and office. The building size was revealed to be 35,000 sf with 4,000 sf designated as office space. Upon review of the structure from both the exterior and interior the industrial building and office quality and condition were determined to be average. No basements or mezzanines were evident.

Summary data for both the windshield and detailed survey are presented in Table 12.

Case Study #2 The business examined under case study #2 is one of five businesses located in one building. From the exterior inspection performed in the windshield survey, the total building appeared to be of an industrial nature and, as per the Marshall and Swift Valuation Service, an engineering type building. From the exterior, the building and its individual tenants appears to be of good quality and condition. The size was estimated from topographic photos as 63,400 sf for the total structure and the case study business size approximated at 9,600 sf. Based on visual inspection and what was considered typical for the area, the structure was not considered to have a basement or mezzanine.

Once the detailed survey was performed and the interior of the building inspected, the occupancy of the structure was established to be of an industrial nature but more of a "flex" type structure as defined by Marshall & Swift. The quality of construction was considered to be average for a "flex" type building and the condition was determined to be good. The size as provided by the president of the business being surveyed was 65,200 for the total building and 8,400 for the business. Basements and mezzanines were not present.

Survey summary information for both the windshield and detailed survey of case study #2 is presented in Table 12.

Case Study #3 Based on the exterior inspection performed under the windshield survey, the structure was determined to be a restaurant of good quality and condition. The size of the structure was estimated from topographic photos to be 1,375 sf. Based on the exterior inspection and what was considered typical for the area, the structure was considered to have a basement.

Under the detailed survey, it was evident that significant rehabilitation had occurred in the past several years to the exterior facing and interior design of the structure. The structure was determined to be of average quality and good condition. The size of the structure was identified by the owner to be 1,546 sf. The structure does have a basement for storage.

A summary of survey data for both the windshield and detailed survey of case study #3 is presented in Table 12.

Case Study #4 Under the windshield survey, this single-family ranch structure was determined to be of good quality and good condition. Based on the exterior inspection and what is typical of single-family structures in this area, the structure was determined to be wood-frame with the basement considered a gameroom type. Based on topographic photographs, the structure size was approximated at 825 sf.

Under the detailed survey, this single-family ranch was determined to be of average-good quality for the main house and average quality for the basement. Both the main house and basement were determined to be of average condition. The detailed survey revealed the basement to be half-finished (framed and carpeted) and half only waterproofed. The structure size was determined to be 816 sf.

A summary of data for both the windshield and detailed survey is presented in Table 13.

Case Study #5 This single-family colonial was determined to be of good quality and condition under the windshield survey. The type/classification was identified as wood-frame with a basement based on the visual inspection. In addition, based on what is considered typical of the area, the basement was assumed to be a game room type. Based on topographic surveys, the structure size was approximated at 1,125 sf with a 600 sf attached garage.

Based on the detailed survey, this single-family colonial was determined to be of good quality for the main house and its addition, with a fair basement. The condition was determined to be good for the main house, excellent for the addition, and average for the basement. The structure size was determined to be 672 sf for the main house, 486 sf for the addition, and 336 sf for the basement.

Summary data for both the windshield and detailed surveys are presented in Table 13.

Market Data

As outlined in Chapter 4, determination of structure value less depreciation utilizing market data is achieved by surveying the study area, identifying structure types and interviewing/contacting local realtors or assessors. These steps are shared by both the limited and detailed level of study. A detailed level of study would also incorporate developing a set of guidelines of structure reference on which to base all structure value determinations for the study. Since only five structures in differing towns are being examined, the detailed market data approach is not applicable for the case studies.

Information required to determine structure value less depreciation for the case studies was obtained by performing an exterior survey, identifying the structure types, and contacting/interviewing local realtors or assessors. The structure information included data related to the type as well as an estimation of size, age, and condition. The information obtained is summarized in Table 14.

Tax Data

Similar to the Market Data approach, the limited level of study for determination of structure value less depreciation utilizing tax data is achieved by surveying the study area, identifying structure types and interviewing/contacting local tax assessors. In addition, as described in Chapter 4, the tax data should be verified to determine that the assessment was performed recently, consideration is granted to effective age or similar elements, economic depreciation is negligible, and assessment of land and improvements are separate. These steps are shared by both the limited and detailed level of study. A detailed level of study would also incorporate developing a set of guidelines of structure reference (similar to market data approach) on which to base all structure value determinations for the study. Since only five structures in differing towns are being examined, the detailed tax data approach is not applicable for the case studies.

Information required to determine structure value less depreciation for the case studies was obtained by performing an exterior survey, identifying the structure types, and contacting/interviewing tax assessors. The structure information included data related to the type as well as an estimation of size, age, and condition. The information obtained is summarized in Table 15.

Sample Analyses

Depreciated Replacement Cost

As previously discussed, the analysis of depreciated replacement cost required two distinct steps; the first being the calculation of replacement cost and the second being the determination of depreciation. Either a windshield (exterior) or detailed (including interior) level of study may be used.

Determination of the replacement cost is based on field data related to the occupancy, type/classification, quality of construction, number of stories, and building size for either the windshield or detailed study. Detailed study takes into account such factors as foundations and substructures, framing and superstructure, exterior closure, roofing, interior construction, specialties, mechanical and electrical equipment and conveying systems. Using a standard cost valuation reference, in this case Marshall and

Table 14 - Market Data Collection Summary Case Studies #1 - #5

CASE STUDY	#1	#2	#3	#4	#5
Location	Fairfield	Fairfield	Ramsey	Pompton Lakes	Pequannock Township
Structure	Business	Business	Business	Residential	Residential
Style	Industrial & Office	Industrial	Restaurant	Single-Family Ranch No Garage	Single-Family Colonial (2-Story) Garage
Estimated Size (sf)	36,000 (4,000 Office)	9,600	1,375	825	1,125
Estimated Age (yrs)	30	5-10	25	40	15-20
Condition	Average	Good	Good	Good	Very Good

Table 15 - Tax Data Collection Summary Case Studies #1 - #5

CASE STUDY	#1	#2	#3	#4	#5
Location	Fairfield	Fairfield	Ramsey	Pompton Lakes	Pequannock Township
Structure	Business	Business	Business	Residential	Residential
Style	Industrial & Office	Industrial	Restaurant	Single-Family Ranch No Garage	Single-Family Colonial (2-Story) Garage
Estimated Size (sf)	36,000 (4,000 Office)	9,600	1,375	825	1,125
Estimated Age (yrs)	30	5-10	25	40	15-20
Condition	Average	Good	Good	Good	Very Good
Assessed Date	1988-89	1988-89	1987	1993	1986
Equalization Factor	96.57%	96.57%	89.48%	93.10%	66.66%

Swift, the replacement cost was derived based on the field data collected and the applicable cost and location multipliers. Utilizing the methods outlined in Chapter 4 and the Marshall Valuation Service, replacement cost estimates for both windshield and detailed level of effort for case studies #1 - #5 are presented in Tables 16 - 25.

Replacement costs in the case studies are estimated from a general unit price for the typical structure based on the occupancy, type/classification, quality and refinements. This unit price is then adjusted by current and local cost multipliers to arrive at a unit cost to apply to the structure. Under the detailed level of study, unit costs are derived for the individual building components which are then utilized to arrive at the subtotal cost which is then adjusted by current and local cost multipliers to arrive at the replacement cost. Under case study #2, the replacement value of one business of a multi-tenant structure is based on a portion of the value of the entire structure. The ratio of the size of the business to the entire building is applied to the replacement value of the entire structure to determine the replacement value of the individual business.

Determination of depreciation is based on the occupancy and condition of the structure which are directly related to the remaining life of the structure. Remaining life was then related to the depreciation of the structure. Under a detailed level of study, it was considered that different components of a structure may be in vastly different condition. In this case, the overall depreciation of the structure was evaluated by weighting the level of depreciation for each component by that component's proportion of the structure's total value. Table 21 presents a sample of this depreciation calculation method.

Utilizing the information presented in Tables 7 - 10 of Chapter 4, depreciation percentages and amounts are presented for both windshield and detailed level of effort for Case Studies #1 - #5 in Tables 16 - 25.

Once the depreciation amount is determined, this value is subtracted from the calculated replacement cost to determine the depreciated replacement cost. The replacement value less depreciation for both windshield and detailed level of effort for Case Studies #1 - #5 are presented in Tables 16 - 25.

Market Data

Determination of structure value less depreciation utilizing market data is achieved by surveying the study area, identifying structure types and interviewing/contacting local realtors or assessors. As noted above, the information gained from the survey was summarized to include structure type, style, size, age, condition, etc. for each of the structures in the case studies. The local realtors and/or assessors were then contacted for information on structures fitting the description in the summaries. Utilizing the information presented in Chapter 4, structure value for the case studies utilizing market data are presented in Table 26.

TABLE 16
CASE STUDY #1
DEPRECIATED REPLACEMENT COST WINDSHIELD SURVEY
(Based on Marshall & Swift, Marshall Valuation Service)

Survey Date:	08/94	**Interviewer (Initials):**	
Building Name:	Sample Business 1	**Contact:**	Mr. Jones
Address:	Business 1 Road	**Title:**	Owner
	Fairfield, NJ 07006	**Phone:**	(201) 555-1111

BUILDING DATA SUMMARY	Section I	Section II	Section III	Section IV
Occupancy	Indust, Manufact	Office		
Building Class	C	B		
Quality	Average	Average		
Exterior Wall	Block	Block		
No. Stories	1	2		
Avg. Floor Area	32,000	2,000		
Avg. Perimeter	820	140		
Condition	Avg-Fair	Average		
Remaining Life	20	30		
Life Expectancy	50	55		

	Section I	Section II	Section III	Section IV
BASE SQUARE FOOT COST	$24.95	$69.16	$0.00	$0.00
SQUARE FOOT REFINEMENTS				
Basement	$0.00	$0.00	$0.00	$0.00
Garage	$0.00	$0.00	$0.00	$0.00
Miscellaneous	$0.00	$0.00	$0.00	$0.00
Subtotal	$24.95	$69.16	$0.00	$0.00
HEIGHT AND SIZE REFINEMENTS				
No. Stories Multiplier	1	1	0	0
Floor area-perimeter Mult.	0.935	1.001	0	0
Combined Mult.	0.935	1.001	0	0
FINAL CALCULATIONS				
Refined sf cost	$23.33	$69.23	$0.00	$0.00
Cost multiplier	1.05	1.07	0	0
Local multiplier	1.27	1.26	0	0
Final sf cost	$31.11	$93.34	$0.00	$0.00
Area	32,000	4,000	0	0
	$995,520	$373,360		
Lump Sum Cost	-			
REPLACEMENT COST	$995,520	$373,360	$0	$0
Depreciation %	34.0%	19.0%	0.0%	0.0%
Depreciation amount	$338,477	$70,938	$0	$0
DEPRECIATED COST	$657,043	$302,422	$0	$0

REPLACEMENT COST	$1,368,880
DEPRECIATION	$409,415
DEPRECIATED REPL. COST	$959,465

Note: Survey based on eastern region, moderate climate & Mar '94 current & Jan '94 local cost multipliers.

TABLE 17
CASE STUDY #1
DEPRECIATED REPLACEMENT COST DETAILED SURVEY
(Based on Marshall & Swift, Marshall Valuation Service)

Survey Date:	08/94	**Analyst (Initials):**	
Building Name:	Sample Business 1	**Contact:**	Mr. Jones
Address:	Business 1 Road	**Title:**	Owner
	Fairfield, NJ 07006	**Phone:**	(201) 555-1111

	Section I	Section II	Section III
Occupancy	*Indust, Manufact*	*Office*	
Building Class	C - Masonry, Conc. Wall	B	
Quality	Average	Average	
No. Stories	1	2	
Height per Story (ft)	12	12	
Avg. Floor Area	31,000	2,000	(one story)
Avg. Perimeter	820	240	
Age (yrs)	40	40	
Condition	Average	Average	
Remaining Life	25	30	
Life Expectancy	50	55	

UNIT COSTS

		No	Section I	No	Section II	No	Section III
FLOOR AREA COSTS							
Excavation	I & II Site Preparation Only - Average	2	$0.14	2	$0.16		
Foundation	I - Class C, Non-Bearing Wall - Avg.; II - Class B, Avg.	2	$1.75	2	$1.74		
Frame	I - @ Grade, No Framing; II - 2nd Story Conc-Steel, Class B-Avg.	2	$0.00	2	$0.00		
Floor Structure	I-Conc@Grade-Avg;II-1 Stry Conc@Grade, 2nd Steel Joist, Flt Slab-A	2	$2.27	2	$9.51		
Floor Cover	I - Hard/Seal; II - 75% Carpet, 25% Vinyl Tile - Avg.	2	$0.51	2	$2.45		
Ceiling	I - Exposed, No Cost; II - Acoustic Tile Incl Pad & Susp. Syst - Avg	2	$0.00	2	$4.75		
Interior Construction	I - Frame Int. Part, Indust - Avg.; II - Frame Int Part, Office B - Avg.	2	$1.25	2	$15.86		
Plumbing	I - Typ. Indust Standard - Avg; II - Typ. Office - Avg.	2	$1.12	2	$2.78		
Sprinklers	I - 31,000 sf, Low; II - 4,000 sf - Avg.	2	$1.37	2	$2.13		
Heating, Cooling, Vent	I & II Gas Forced Air - Avg; II - Air Cond. - Avg	2	$1.69	2	$3.95		
Electrical	I - Typ. Indust - Avg; II - Typ. Office B - Avg.	2	$2.52	2	$5.82		
	Total Floor Costs		$12.62		$49.15		$0.00
WALL COSTS							
Exterior Walls	I - 8" Conc. Block - Avg; II - Brick, Block Backup, 8" - Avg. (2 Story)	2	$9.92	2	$13.86		
Wall Ornamentation	I - No Ornamentation; II - No Ornamentation	2	$0.00	2	$0.00		
ROOF COSTS							
Roof Structure	I - Steel Jst, Conc Slab - Avg; II -Steel Jst, Conc Slab - Avg	2	$6.59	2	$7.31		
Roof Cover	I - Built up Comp - Avg; II - Built up Comp - Avg	2	$1.01	2	$1.22		
Trusses	I & II - Flat no Truss	2	$0.00	2	$0.00		
	Total Roof Costs		$7.60		$8.53		$0.00

FINAL CALCULATIONS

		Section I	Section II	Section III
Floor Area Costs (Unit Cost * Area)		$391,313	$196,600	$0
Exterior Walls (Unit Cost * Area)		$97,613	$79,834	$0
Wall Ornament (Unit Cost * Area)		$0	$0	$0
Roof (Unit Cost * Area)		$235,600	$17,060	$0
Section Sub Totals		$724,526	$293,494	$0
Number of Stories Multiplier	x	1	1	0
Section Totals		$724,526	$293,494	$0
Architect's Fees		1.017	1.025	0
Current Cost Multiplier		1.05	1.07	0
Local Cost Multiplier		1.27	1.26	0
Final Multiplier		1.356	1.382	0
Refined Section Totals		$982,457	$405,609	$0
Lump Sums		$0	$0	$0
REPLACEMENT COST		$982,457	$405,609	$0
Depreciation %		25%	19%	0%
Depreciation Amount		$245,614	$77,066	$0
DEPRECIATION COST		$736,843	$328,543	$0

REPLACEMENT COST	$1,388,066
DEPRECIATION	$322,680
DEPRECIATED REPL. COST	$1,065,386

Note: Survey based on eastern region, moderate climate, and March 1994 current cost multipliers & Jan 1994 local cost multipliers.

TABLE 18
CASE STUDY #2
DEPRECIATED REPLACEMENT COST WINDSHIELD SURVEY
(Based on Marshall & Swift, Marshall Valuation Service)

Survey Date:	08/94	**Interviewer (Initials):**	
Building Name:	Sample Business 2	**Contact:**	Ms. Smith
Address:	Business 2 Road	**Title:**	President
	Fairfield, NJ 07006	**Phone:**	(201) 555-2222
	(1 of 5 Tenants in Building)		

BUILDING DATA SUMMARY	**Section I**	**Section II**	**Section III**	**Section IV**
Occupancy	Indust, Engineer Building			
Building Class	C			
Quality	Good			
Exterior Wall	Dec. Block			
No. Stories	1			
Avg. Floor Area	63,400	9,600 (for Sample Business 2)		
Avg. Perimeter	1,165	440 (for Sample Business 2)		
Condition	Good			
Remaining Life	35			
Life Expectancy	50			

	Section I	**Section II**	**Section III**	**Section IV**
BASE SQUARE FOOT COST	$49.27	$0.00	$0.00	$0.00
SQUARE FOOT REFINEMENTS				
Basement	$0.00	$0.00	$0.00	$0.00
Garage	$0.00	$0.00	$0.00	$0.00
Miscellaneous	$0.00	$0.00	$0.00	$0.00
Subtotal	$49.27	$0.00	$0.00	$0.00
HEIGHT AND SIZE REFINEMENTS				
No. Stories Multiplier	1	0	0	0
Floor area-perimeter Mult.	0.901	0	0	0
Combined Mult.	0.901	0	0	0
FINAL CALCULATIONS				
Refined sf cost	$44.39	$0.00	$0.00	$0.00
Cost multiplier	1.05	0	0	0
Local multiplier	1.27	0	0	0
Final sf cost	$59.19	$0.00	$0.00	$0.00
Total Area	63,400	9,600 (for Sample Business 2)		0
	$3,752,646	$568,224	(Based on Ratio of Tenant sf to Total sf)	
Lump Sum Cost	-			
REPLACEMENT COST	$3,752,646	$568,224	$0	$0
Depreciation %	-	11.0%	0.0%	0.0%
Depreciation amount	-	$62,505	$0	$0
DEPRECIATED COST	-	$505,719	$0	$0

REPLACEMENT COST	$568,224
DEPRECIATION	$62,505
DEPRECIATED REPL. COST	$505,719

Note: Survey based on eastern region, moderate climate & Mar '94 current & Jan '94 local cost multipliers.

TABLE 19
CASE STUDY #2
DEPRECIATED REPLACEMENT COST DETAILED SURVEY
(Based on Marshall & Swift, Marshall Valuation Service)

Survey Date:	08/94	**Analyst (Initials):**	
Building Name:	Sample Business 2	**Contact:**	Ms. Smith
Address:	Business 2 Road	**Title:**	President
	Fairfield, NJ 07006	**Phone:**	(201) 555-2222
	(1 of 5 Tenants in Building)		

	Section I	Section II	Section III
Occupancy	Indust, Flex Building		
Building Class	C		
Quality	Average		
No. Stories	1		
Height per Story (ft)	20		
Avg. Floor Area	65,200	8,400 (for Sample Business 2)	
Avg. Perimeter	1020		
Age (yrs)	12		
Condition	Good		
Remaining Life	35		
Life Expectancy	50		

UNIT COSTS

		No	Section I	No	Section II	No	Section II
FLOOR AREA COSTS							
Excavation	I&II-Site Preparation Only-Avg	2	$0.19				
Foundation	I&II-Class C, Masonry	2	$1.61				
Frame	I&II-Class B, Reinf. Concrete	2	$9.16				
Floor Structure	I&II-Concrete @ Grade - Avg	2	$2.27				
Floor Cover	83% Hardener & Sealer Avg.,17% Carpet Low	2/1	$0.65				
Ceiling	83% Exposed No Cost, 17% Acoustic Tile -Avg	2	$4.15				
Interior Construction	Frame Interior Partition, Flex Building - Avg.	2	$2.74				
Plumbing	Typical Flex Building - Avg	2	$1.40				
Sprinklers	65,200 sf Total Flex Building	2	$1.22				
Heating, Cooling, Vent	Approx 80% Space Heater, 20% Forced Air	2	$1.02				
Electrical	Typical Flex Building - Avg	2	$2.32				
	Total Floor Costs		$26.74		$0.00		$0.00
WALL COSTS							
Exterior Walls	12" Block Plus Ornamented Face Block	2	$12.27				
Wall Ornamentation	Face Block Already Accounted For	2	$0.00				
ROOF COSTS							
Roof Structure	Steel Joist, Concrete Slab - Avg	2	$6.59				
Roof Cover	Built up Composition - Avg	2	$1.01				
Trusses	Flat Roof, No Truss	2	$0.00				
	Total Roof Costs		$7.60		$0.00		$0.00

FINAL CALCULATIONS

	Section I	Section II	
Floor Area Costs (Unit Cost * Area)	$1,743,252	$0	$0
Exterior Walls (Unit Cost * Area)	$250,308	ERR	$0
Wall Ornament (Unit Cost * Area)	$0	ERR	$0
Roof (Unit Cost * Area)	$495,520	$0	$0
Section Sub Totals	$2,489,080	ERR	$0
Number of Stories Multiplier x	1	0	0
Section Totals	$2,489,080	ERR	$0
Architect's Fees	1.025	0	0
Current Cost Multiplier	1.05	0	0
Local Cost Multiplier	1.27	0	0
Final Multiplier	1.367	0	0
Refined Section Totals	$3,402,572	ERR	$0
Lump Sums	$0	$0	$0
REPLACEMENT COST	$3,402,572	$500,992	(Based on Ratio of Tenant sf to Total sf)
Depreciation %	-	11%	0%
Depreciation Amount	-	$55,109	$0
DEPRECIATION COST	-	$445,883	$0

REPLACEMENT COST	$500,992
DEPRECIATION	$55,109
DEPRECIATED REPL. COST	$445,883

Note: Survey based on eastern region, moderate climate, and March 1994 current cost multipliers & Jan 1994 local cost multipliers.

TABLE 20
CASE STUDY #3
DEPRECIATED REPLACEMENT COST WINDSHIELD SURVEY
(Based on Marshall & Swift, Marshall Valuation Service)

Survey Date:	08/94	**Interviewer (Initials):**	
Building Name:	Sample Business 3	**Contact:**	Mr. Johnson
Address:	Business 3 Road	**Title:**	Owner
	Ramsey, NJ 07446	**Phone:**	(201) 555-3333

BUILDING DATA SUMMARY	Section I	Section II	Section III	Section IV
Occupancy	Restaurant, Stand Alone			
Building Class	C			
Quality	Good			
Exterior Wall	Masonry & Glass Block			
No. Stories	1			
Avg. Floor Area	1,375			
Avg. Perimeter	160			
Condition	Good			
Remaining Life	25			
Life Expectancy	35			

	Section I	Section II	Section III	Section IV
BASE SQUARE FOOT COST	$76.39	$0.00	$0.00	$0.00
SQUARE FOOT REFINEMENTS				
Basement Storage	$16.29	$0.00	$0.00	$0.00
Garage	$0.00	$0.00	$0.00	$0.00
Miscellaneous	$0.00	$0.00	$0.00	$0.00
Subtotal	$92.68	$0.00	$0.00	$0.00
HEIGHT AND SIZE REFINEMENTS				
No. Stories Multiplier	1	0	0	0
Floor area-perimeter Mult.	1.263	0	0	0
Combined Mult.	1.263	0	0	0
FINAL CALCULATIONS				
Refined sf cost	$117.05	$0.00	$0.00	$0.00
Cost multiplier	1.04	0	0	0
Local multiplier	1.25	0	0	0
Final sf cost	$152.17	$0.00	$0.00	$0.00
Area	1,375	0	0	0
	$209,234	$0		
Lump Sum Cost	-			
REPLACEMENT COST	$209,234	$0	$0	$0
Depreciation %	15.0%	0.0%	0.0%	0.0%
Depreciation amount	$31,385	$0	$0	$0
DEPRECIATED COST	$177,849	$0	$0	$0

REPLACEMENT COST	$209,234
DEPRECIATION	$31,385
DEPRECIATED REPL. COST	$177,849

Note: Survey based on eastern region, moderate climate & Mar '94 current & Jan '94 local cost multipliers.

TABLE 21
CASE STUDY #3
DEPRECIATED REPLACEMENT COST DETAILED SURVEY
(Based on Marshall & Swift, Marshall Valuation Service)

Survey Date:	08/94	**Analyst (Initials):**	
Building Name:	Sample Business 3	**Contact:**	Mr. Johnson
Address:	Business 3 Road	**Title:**	Owner
	Ramsey, NJ 07446	**Phone:**	(201) 555-3333

	Section I	Section II	Section III
Occupancy	Restaurant, Stand Alone	Basement	
Building Class	C	C	
Quality	Average	Average	
No. Stories	1	1	
Height per Story (ft)	12	12	
Avg. Floor Area	1,546	1,546	
Avg. Perimeter	170	170	
Age	60	60	
Condition	Good	Average	
Remaining Life	25	25	
Life Expectancy	35	35	

UNIT COSTS

		No	Section I	No	Section II	No	Section III
FLOOR AREA COSTS							
Excavation	I - None, II - Excavation @ 8'	2	$0.00	2	$1.44		
Foundation	I -Concrete Block for Class, Bearing Wall, Avg	2	$1.44	2	$1.01		
Frame	I-Brng Wall, Wd Flr Support Only,Avg.; II-@ Grade, None	2	$0.83	-	$0.00		
Floor Structure	I-Wood Jsts & Shthng, Avg; II - Conc. @ Grade	2	$3.49	2	$2.26		
Floor Cover	I -Marble 100%,Average; II- No Cover	2	$16.50	-	$0.00		
Ceiling	I-Acstcl Tile, Incl. Pads & Susp Syst, Above Avg;II - Open	3	$5.55	-	$0.00		
Interior Construction	I-Frame Int. Part, Rstrnt, Tbl Srvce, Avg; II - None	2	$12.91	-	$0.00		
Plumbing	I-Restaurant, Higher Quality, Avg; II - None	2	$6.46	-	$0.00		
Sprinklers	I & II -No Sprinkler System	2	$0.00	-	$0.00		
Heating, Cooling, Vent	I - Forced Warm and Cool Air, Avg.; II - Low	2	$8.00	1	$3.05		
Electrical	I-Rstrnt, Higher Quality, Above Avg; II-Unfnshed Area	3	$8.03	2	$0.99		
	Total Floor Costs		$63.21		$8.75		$0.00
WALL COSTS							
Exterior Walls	I-60%Conc Blck W/Sdng,Above Avg,40% Str Frnt;II-Bsmt Walls	2	$17.93	2	$7.00		
Wall Ornamentation	I & II - No Additional Ornamentation	2	$0.00	-	$0.00		
ROOF COSTS							
Roof Structure	I - Wood Joists & Sheathing - Avg.;II - None	2	$2.98	-	$0.00		
Roof Cover	I - Composition Shingles - Avg.; II - None	2	$0.95	-	$0.00		
Trusses	None	2	$0.00	-	$0.00		
	Total Roof Costs		$3.93		$0.00		$0.00

FINAL CALCULATIONS

	Section I	Section II	Section III
Floor Area Costs (Unit Cost * Area)	$97,723	$13,524	$0
Exterior Walls (Unit Cost * Area)	$36,577	$14,280	$0
Wall Ornament (Unit Cost * Area)	$0	$0	$0
Roof (Unit Cost * Area)	$6,076	$0	$0
Section Sub Totals	$140,376	$27,804	$0
Number of Stories Multiplier x	1	1	0
Section Totals	$140,376	$27,804	$0
Architect's Fees	1.07	1.07	0
Current Cost Multiplier	1.04	1.04	0
Local Cost Multiplier	1.25	1.25	0
Final Multiplier	1.391	1.391	0
Refined Section Totals	$195,263	$38,675	$0
Lump Sums Bsmt Stair-12 risr	$0	$734	$0
REPLACEMENT COST	$195,263	$39,409	$0
Depreciation %	10.3%	32%	0%
Depreciation Amount	$20,112	$12,611	$0
DEPRECIATION COST	$175,151	$26,798	$0

REPLACEMENT COST	$234,672
DEPRECIATION	$32,723
DEPRECIATED REPL. COST	$201,949

Note: Survey based on eastern region, moderate climate, and March 1994 current cost multipliers & Jan 1994 local cost multipliers.

TABLE 22
CASE STUDY #4
DEPRECIATED REPLACEMENT COST WINDSHIELD SURVEY
(Based on Marshall & Swift, Marshall Valuation Service)

Survey Date:	08/94	**Interviewer (Initials):**	
Building Name:	Sample Residence 1	**Contact:**	Mr. Adams
Address:	Sample 1 Street	**Title:**	Owner
	Pompton Lakes, NJ 07442	**Phone:**	(201) 555-5111

BUILDING DATA SUMMARY	**Section I**	**Section II**	**Section III**	**Section IV**
Occupancy	Single Family Res			
Building Class	D			
Quality	Good			
Exterior Wall	Siding			
No. Stories	1			
Avg. Floor Area	825			
Condition	Good			
Remaining Life	40			
Life Expectancy	55			

	Section I	**Section II**	**Section III**	**Section IV**
BASE SQUARE FOOT COST	$58.56	$0.00	$0.00	$0.00
SQUARE FOOT REFINEMENTS				
Basement	$19.13	$0.00	$0.00	$0.00
Garage	$0.00	$0.00	$0.00	$0.00
Miscellaneous	$0.00	$0.00	$0.00	$0.00
Subtotal	$77.69	$0.00	$0.00	$0.00
HEIGHT AND SIZE REFINEMENTS				
No. Stories Multiplier	1	0	0	0
Combined Mult.	1	0	0	0
FINAL CALCULATIONS				
Refined sf cost	$77.69	$0.00	$0.00	$0.00
Cost multiplier	1.03	0	0	0
Local multiplier	1.25	0	0	0
Final sf cost	$100.03	$0.00	$0.00	$0.00
Area	825	0	0	0
	$82,525			
Lump Sum Cost	-			
REPLACEMENT COST	$82,525	$0	$0	$0
Depreciation %	15.0%	0.0%	0.0%	0.0%
Depreciation amount	$12,379	$0	$0	$0
DEPRECIATED COST	$70,146	$0	$0	$0

REPLACEMENT COST	$82,525
DEPRECIATION	$12,379
DEPRECIATED REPL. COST	$70,146

Note: Based on eastern region, moderate climate, Mar '94 current & Jan '94 local cost mult.

TABLE 23
CASE STUDY #4
DEPRECIATED REPLACEMENT COST DETAILED SURVEY
(Based on Marshall & Swift, Marshall Valuation Service)

Survey Date:	08/94	**Analyst (Initials):**	
Building Name:	Sample Residence 1	**Contact:**	Mr. Adams
Address:	Sample 1 Street	**Title:**	Owner
	Pompton Lakes, NJ 07442	**Phone:**	(201) 555-5111

	Section I	Section II	Section III
Occupancy	***Single Family Residence***	***Basement***	
Building Class	D - Wood Frame	C - Masonry Block	
Quality	Average-Good	Average	
No. Stories	1	1	
Height per Story (ft)	8	8	
Avg. Floor Area	816	816	
Avg. Perimeter	83	83	
Shape	Rectangular	Rectangular	
Age (yrs)	40	40	
Condition	Average	Average	
Remaining Life	40	40	
Life Expectancy	55	55	

UNIT COSTS

		No	Section I	No	Section II	No	Section II
FLOOR AREA COSTS							
Excavation	I-Site Preparation - Avg.;II - Excav. (10'*$.20/cf=$2.00/sf)	2	$0.16	2	$2.00		
Foundation	I- Masonry, Conc. Block for Class D Siding -Avg ; II- Class C Bearng Wall - Avg	2	$1.21	2	$1.65		
Frame	I-816 sf Brng Wlls, Wd Floor Spprt; II - No Framing	2	$0.76	-	$0.00		
Floor Structure	I-Wood:Jsts & Shthng; II - No Cost	2	$3.44	-	$0.00		
Floor Cover	I-25% Crpt,3% Crmc Tile,47% Hrdwd Floor,25% Reslnt Flr Covr-Avg.);II-50%Cr	2	$4.24	2	$0.93		
Ceiling	I & II - Gypsum + Insullation	2	$1.57	2	$1.57		
Interior Construction	I-Frame Int Part, Single Fam Res-Avg.; II-50% Similar Typ. Family Res	2	$11.05	2	$5.53		
Plumbing	I & II- Standard Single Family Residence - Avg.	2	$3.49	2	$3.49		
Sprinklers	I & II - No Cost	-	$0.00	-	$0.00		
Heating, Cooling, Venti	I & II - Heat Forced Air - Avg; AC Wall Units Only	2	$1.75	2	$1.75		
Electrical	I - Typical Single Family Residence - Avg; II - Typical Single Family - Avg.	2	$2.33	2	$2.33		
	Total Floor Area		$30.00		$19.25		$0.00
WALL COSTS							
Exterior Walls	I - Vinyl Sdng (Good)+ Shthng+Insltn (Avg); II - 50% Wtrprf Blck, 50% Frmd Int	3/2	$11.87	2	$7.73		
Wall Ornamentation	I & II No Ornamentation	-	$0.00	-	$0.00		
ROOF COSTS							
Roof Structure	I - Wood Joists, Wood/Composition Deck-Avg (1:2 Pitch); II - No Cost	2	$3.30	-	$0.00		
Roof Cover	I - Composition Shingle - Avg.(1:2 Pitch); II - No Cost	2	$1.06	-	$0.00		
Trusses	I - Timber Trusses - Avg.; II - No Cost	2	$1.64	-	$0.00		
	Total Roof Costs		$6.00		$0.00		$0.00

FINAL CALCULATIONS

	Section I	Section II	Section III
Floor Area Costs (Unit Cost * Area)	$24,480	$15,704	$0
Exterior Walls (Unit Cost * Area)	$7,882	$5,133	$0
Wall Ornament (Unit Cost * Area)	$0	$0	$0
Roof (Unit Cost * Area)	$4,896	$0	$0
Section Sub Totals	$37,258	$20,837	$0
Number of Stories Multiplier x	1	1	1
Section Totals	$37,258	$20,837	$0
Architect's Fees	1.013	1.013	0
Current Cost Multiplier	1.03	1.03	0
Local Cost Multiplier	1.27	1.26	0
Final Multiplier	1.325	1.315	0
Refined Section Totals	$49,367	$27,401	$0
Lump Sums	$0	$0	$0
REPLACEMENT COST	$49,367	$27,401	$0
Depreciation %	15%	15%	0%
Depreciation Amount	$7,405	$4,110	$0
DEPRECIATION COST	$41,962	$23,291	$0

REPLACEMENT COST	$76,768
DEPRECIATION	$11,515
DEPRECIATED REPL. COST	$65,253

Note: Survey based on eastern region, moderate climate, and March 1994 cost multipliers.

TABLE 24
CASE STUDY #5
DEPRECIATED REPLACEMENT COST WINDSHIELD SURVEY
(Based on Marshall & Swift, Marshall Valuation Service)

Survey Date:	08/94	**Interviewer (Initials):**	
Building Name:	Sample Residence 2	**Contact:**	Mr. Edwards
Address:	Sample 2 Street	**Title:**	Owner
	Pequannock Twp., NJ 07444	**Phone:**	(201) 555-5222

BUILDING DATA SUMMARY	Section I	Section II	Section III	Section IV
Occupancy	Single Family Res	Garage		
Building Class	D	D		
Quality	Good	Good		
Exterior Wall	Siding, Vinyl	Siding, Vinyl		
No. Stories	2	1		
Avg. Floor Area	1,125	600		
Condition	Good	Good		
Remaining Life	40	40		
Life Expectancy	55	55		

		Section I	Section II	Section III	Section IV
BASE SQUARE FOOT COST		$58.56	$0.00	$0.00	$0.00
SQUARE FOOT REFINEMENTS					
Basement	(Game Room)	$19.13	$0.00	$0.00	$0.00
Garage	(Adj.Share Wall)	$0.00	$17.22	$0.00	$0.00
Miscellaneous		$0.00	$0.00	$0.00	$0.00
Subtotal		$77.69	$17.22	$0.00	$0.00
HEIGHT AND SIZE REFINEMENTS					
No. Stories Multiplier		1	1	0	0
Combined Mult.		1	1	0	0
FINAL CALCULATIONS					
Refined sf cost		-	$17.22	$0.00	$0.00
Cost multiplier		1.03	1.03	0	0
Local multiplier		1.27	1.27	0	0
Final sf cost		-	$22.53	$0.00	$0.00
Area		2,500	600	0	0
		$222,786	$13,518		
Lump Sum Cost - Deck, Fireplace		$6,991	-		
REPLACEMENT COST		$229,777	$13,518	$0	$0
Depreciation %		15.0%	15.0%	0.0%	0.0%
Depreciation amount		$34,467	$2,028	$0	$0
DEPRECIATED COST		$195,310	$11,490	$0	$0

REPLACEMENT COST	$243,295
DEPRECIATION	$36,495
DEPRECIATED REPL. COST	$206,800

Note: Based on eastern region, moderate climate, Mar '94 current & Jan '94 local cost mult.

TABLE 25
CASE STUDY #5
DEPRECIATED REPLACEMENT COST DETAILED SURVEY
(Based on Marshall & Swift, Marshall Valuation Service)

Survey Date:	08/94	**Analyst (Initials):**	
Building Name:	Sample Residence 2	**Contact:**	Mr. Edwards
Address:	Sample 2 Street	**Title:**	Owner
	Pequannock Twp., NJ 07444	**Phone:**	(201) 555-5222

	Section I	Section II	Section III
Occupancy	***Single Family Residence Basement***		***Addition - Family Room***
Building Class	D - Wood Frame	C - Masonry Block	D - Wood Frame
Quality	Good	Fair	Good
No. Stories	2	1	2
Height per Story (ft)	8	8	8
Avg. Floor Area	672	336	486
Avg. Perimeter	104	76	90
Shape	Rectangular	Rectangular	Rectangular
Age (yrs)	30	30	3
Condition	Good	Average	Excellent
Remaining Life	40	30	50
Life Expectancy	55	55	55

UNIT COSTS

		No	Section I	No	Section II	No	Section II
FLOOR AREA COSTS							
Excavation	I-No;II - Excavation (10"*$.20/cf=$2.00/sf);II-Site Prep	-	$0.00	2	$2.00	2	$0.16
Foundation	I & III- Masonry, Conc. Block for Class D Siding -Avg ; II- Class C Bearng Wall	2	$0.85	2	$1.65	2	$0.85
Frame	I & III- Brng Wlls, Wd Floor Spprt - Avg; II - No Framing	2	$0.76	-	$0.00	2	$0.76
Floor Structure	I & III -Wood: Jsts & Shthng - Avg; II- No Cost	2	$3.44	-	$0.00	2	$3.44
Floor Cover	I-50%Crpt,10%CrmTle,20%Hrdwd,20%RslntCvr-Avg.);II-H&S;III-Crpt-Gd	2	$3.18	-	$0.00	3	$3.00
Ceiling	I, II & III - Gypsum + Insullation	2	$1.57	2	$1.57	2	$1.57
Interior Construction	I-Avg.& III-Good Frame Int Partition, Single Family Res.	2	$11.05	-	$0.00	3	$13.53
Plumbing	I- Standard Single Family Residence - Avg.	2	$3.49	-	$0.00	-	$0.00
Sprinklers	I, II & III - No Cost	2	$0.00	-	$0.00	-	$0.00
Heating, Cooling, Vent	I & III Forced Air, Zoned A.C. Warm & Cool Air	2	$5.90	-	$0.00	2	$5.90
Electrical	I & III Typical Single Family Residence - Avg; II - Few Outlets	2	$2.33	2	$1.60	2	$2.33
	Total Floor Area		$32.57		$6.82		$31.54
WALL COSTS							
Exterior Walls	Vnyl Sdng(Vry Gd)+Shthng+Air Inf Wrp+Insltn(I Avg, III Vry Gd); II - Wtrprf Blc	3/2	$12.02	2	$6.95	3	$12.27
Wall Ornamentation	I & II No Ornamentation	-	$0.00	-	$0.00	-	$0.00
ROOF COSTS							
Roof Structure	I&III-Wood Jsts, Wood/Composition Deck-Avg. (1:1 pitch); II - No Cost	2	$4.19	-	$0.00	2	$4.19
Roof Cover	I & III - Composition Shingle - Avg. (1:1 pitch) ; II - No Cost	2	$1.35	-	$0.00	2	$1.35
Trusses	I & III - Timber Trusses - Avg.; II - No Cost	2	$1.64	-	$0.00	2	$1.64
	Total Roof Costs		$7.18		$0.00		$7.18

FINAL CALCULATIONS

	Section I	Section II	Section III
Floor Area Costs (Unit Cost * Area)	$43,774	$2,292	$30,657
Exterior Walls (Unit Cost * Area)	$20,001	$8,451	$17,669
Wall Ornament (Unit Cost * Area)	$0	$0	$0
Roof (Unit Cost * Area)	$4,824	$0	$3,489
Section Sub Totals	$68,599	$10,743	$51,815
Number of Stories Multiplier x	1	1	1
Section Totals	$68,599	$10,743	$51,815
Architect's Fees	1.013	1.013	1.013
Current Cost Multiplier	1.03	1.03	1.03
Local Cost Multiplier	1.27	1.26	1.27
Final Multiplier	1.325	1.315	1.325
Refined Section Totals	$90,894	$14,127	$68,655
Lump Sums (Garage, Deck, Stairs, Fireplace)	$21,149	$0	$0
REPLACEMENT COST	$112,043	$14,127	$68,655
Depreciation %	15%	28%	4%
Depreciation Amount	$16,806	$3,956	$2,746
DEPRECIATION COST	$95,237	$10,171	$65,909

REPLACEMENT COST	$194,825
DEPRECIATION	$23,508
DEPRECIATED REPL. COST	$171,317

Note: Survey based on eastern region, moderate climate, and March 1994 current and Jan 1994 local cost multipliers.

Table 26 - Market Data Structure Values Case Studies #1 - #5					
CASE STUDY	**#1**	**#2**	**#3**	**#4**	**#5**
Location	Fairfield	Fairfield	Ramsey	Pompton Lakes	Pequannock Township
Structure	Business	Business	Business	Residential	Residential
Style	Industrial & Office	Industrial	Restaurant	Single-Family Ranch No Garage	Single-Family Colonial (2-Story) Garage
Estimated Size (sf)	36,000 (4,000 Office)	9,600	1,375	825	1,125
Estimated Age (yrs)	30	5-10	25	40	15-20
Condition	Average	Good	Good	Good	Very Good
Value	$1,302,000	$489,000	$244,000	$79,500	$154,800

Tax Data

Determination of structure value less depreciation utilizing tax data is achieved by surveying the study area, identifying structures, and contacting local tax assessors. For structures in the case studies, local assessors were contacted to obtain assessment information for specific structures and the appropriate equalization factors to be used. Table 27 presents a summary of structure values determined from tax data.

Comparison of Results

Depreciated Replacement Cost

As mentioned above, there are differences in data collection assumptions between the windshield and detailed surveys. These differences are primarily attributed to what was evident from the exterior of the structure and how the interpretation of that information is changed by viewing the structure from both the exterior and interior under the detailed survey. In addition to the variation in assumptions, the detailed level of study examines the structural components on an individual basis rather than using a single unit price as during the windshield survey. Table 28 presents a comparison of the windshield and detailed survey results for the five case studies. The following is a brief description of the variation in results from the windshield to detailed survey depreciated replacement cost methods.

Table 27 - Tax Data Structure Values Case Studies #1 - #5					
CASE STUDY	**#1**	**#2**	**#3**	**#4**	**#5**
Location	Fairfield	Fairfield	Ramsey	Pompton Lakes	Pequannock Township
Structure	Business	Business	Business	Residential	Residential
Style	Industrial & Office	Industrial	Restaurant	Single-Family Ranch No Garage	Single-Family Colonial (2-Story) Garage
Estimated Size (sf)	36,000 (4,000 Office)	9,600	1,375	825	1,125
Estimated Age (yrs)	30	5-10	25	40	15-20
Condition	Average	Good	Good	Good	Very Good
Assessed Date	1988-89	1988-89	1987	1993	1986
Assessed Value	$886,600	$345,000	$141,900	$55,600	$96,600
Equalization Factor	96.57%	96.57%	89.48%	93.10%	66.66%
Equalized Structure Value (Assessed Value ÷ Equal. Factor)	$917,000	$356,800	158,582.92	59,720.73	144,914.49

Case Study #1 Differences in replacement cost less depreciation under the windshield and detailed surveys can be primarily attributed to the following:

- slight variation in size, and
- different calculation methodologies.

Case Study #2 Differences in replacement value less depreciation under the windshield and detailed surveys are essentially due to the following:

- slight variation in size,

Table 28 - Depreciated Replacement Data Comparison of Results for Case Studies #1 Through #5

CASE	# 1		# 2		# 3		#4		#5	
Survey Type	Windshield	Detailed	Windshield	Detailed	Windshield	Detailed	Windshield	Detailed	Windshield	Detailed
Structure	*Business*		*Business*		*Business*		*Residential*		*Residential*	
Location (NJ)	Fairfield		Fairfield		Ramsey		Pompton Lakes		Pequannock Township	
Occupancy	Industrial/ Manufacturing & Office	Industrial/ Manufacturing & Office	Industrial/ Engineer	Industrial/ Flex (Mall)	Restaurant	Restaurant	Single-Family Ranch	Single-Family Ranch	Single-Family Colonial	Single-Family Colonial
Quality	Avg Manufacturing Avg Office	Avg Manufacturing Avg Office	Good	Avg	Good	Avg	Good	Avg-Good House Avg Basement	Good	Good Main Fair Basement Good Addition
Condition	Avg Manufacturing Avg Office	Avg Manufacturing Avg Office	Good	Good	Good	Good	Good	Avg	Good	Good Main Avg Basement Excel Addition
Remaining Life	20 Manufacturing 30 Office	25 Manufacturing 30 Office	35	35	25	25	40	40	40	40 Main 30 Basement 50 Addition
Life Expectancy	50 Manufacturing 55 Office	50 Manufacturing 55 Office	50	50	35	35	55	55	55	55 Main 55 Basement 55 Addition
Replacement Cost	$1,368,900	$1,388,100	$568,200	$501,000	$209,200	$234,700	$85,500	$76,800	$243,300	$194,800
Depreciation	34% Manufacturing 19% Office	25% Manufacturing 19% Office	11%	11%	15%	10.3% 32% Basement	15%	15%	15%	15% Main 28% Basement 4% Addition
Depreciation Amount	$409,400	$322,700	$62,500	$55,100	$31,400	$32,700	$12,400	$11,500	$36,500	$23,500
Replacement Value Less Depreciation	$959,500	$1,065,400	$505,700	$445,900	$177,800	$201,900	$70,100	$65,300	$206,800	$171,300
Variation of Detailed From Windshield	NA	11	NA	-12	NA	14	NA	-7	NA	-17

Table 29 - Comparison of Results for All Structure Value Methods for Case Studies #1 Through #5

CASE STUDY	# 1		# 2		# 3		#4		#5	
METHOD	Structure Value	Variation From Detailed DRC	Structure Value	Variation From Detailed DRC	Structure Value	Variation From Detailed DRC	Structure Value	Variation From Detailed DRC	Structure Value	Variation From Detailed DRC
Depreciated Replacement Cost (DRC) Windshield	$959,500	-0.10	$505,700	0.13	$177,800	-0.12	$70,400	0.08	$206,800	0.21
DRC - Detailed	$1,065,000	-	$445,800	-	$201,800	-	$65,300	-	$171,300	-
Market Data	$1,303,000	0.22	$489,000	0.10	$244,000	0.11	$79,500	0.22	$154,800	-0.10
Tax Data	$918,000	-0.14	$357,300	-0.20	$159,000	-0.21	$59,700	-0.09	$144,900	-0.15

- differing occupancy type and quality, and
- different calculation methodologies.

Under the windshield survey, the structure appeared to be of an industrial, engineering occupancy (as defined by Marshall & Swift). However, under a more detailed survey, the structure was determined to be more of an industrial, flex occupancy (as defined by Marshall & Swift) due to the business layout (manufacturing use).

Case Study #3 Differences in replacement value less depreciation under the windshield and detailed surveys are primarily due to:

- slight variation in size,
- differing quality,
- refinement of depreciation estimation under the detailed analysis, and
- different calculation methodologies.

Case Study #4 Differences in replacement value less depreciation under the windshield and detailed surveys are basically a result of:

- slight variation in size,
- differing quality,
- refinement of basement quality and assumptions, and
- different calculation methodologies.

Case Study #5 Differences in replacement value less depreciation under the windshield and detailed surveys are essentially due to:

- slight variation in size,
- differing quality,
- differences in the size of the game room basement,
- consideration of main structure, addition, and basement with individual qualities, conditions, and unit costs under the detailed analysis, and
- different calculation methodologies.

Overall Results

Table 29 presents a summary of the structure value less depreciation under the four valuation methods for the five case studies.

Problems in Application

Various problems in data collection and interpretation, which were incurred during the case study analyses, are presented below.

Windshield Survey of Businesses:

- Difficult to distinguish specific occupancy from exterior.
- In multiple tenant buildings, it is often difficult to approximate the size of the specific tenant.

- Construction type/classification requires some assumptions based on the physical age. (Newer structures are most likely structural steel with masonry, whereas older stuctures are often load-bearing masonry).
- Basement and mezzanine status may be determined by visual inspection of the exterior if they are exposed, otherwise the analyst must assume a standard for the area based on conversations with local realtors or business employees.

Detailed Survey of Businesses:

- More time consuming than the windshield survey.
- When performing survey, arrange for owner to be present, since tenants and/or business personnel are often not familiar with non-visible building components and/or plan locations.

Windshield Survey of Residences:

- Difficult to identify the quality of construction from exterior. Often, extensive rehabilitation is performed on the exterior of the structure, whereas the interior is not maintained to the same degree. This results in an overestimation of structure value. Conversely, the interior of the structure may be extensively remodelled with no upgrades visible from the exterior. This will result in some inherent variation in the actual to apparent quality condition.
- Construction type/classification requires some assumptions based on the physical age.
- Basement status may be determined by visual inspection if basement is partially exposed, otherwise must assume a standard for the area based on conversations with local realtors or residents.

Detailed Survey of Residences:

- More time consuming than the windshield survey.
- Access to residences must often be scheduled outside of normal working hours.

Chapter 6
Test Procedures

General

As indicated in Chapter 3, many districts currently use depreciated cost techniques to verify the applicability of structure values obtained from market or tax assessment data. In the context of this chapter, these other sources are considered secondary or an indirect measure of the resource value.

ER 1105-2-100 requires that "When structure value data is obtained from sources other than direct estimation of cost of physical replacement less depreciation, these data shall be verified as being reasonable estimates of replacement cost less depreciation. This can be done using a sampling procedure to select a relatively small number of structures for direct estimation of replacement cost less depreciation. The results can be used to compare to, and if appropriate, adjust the data obtained from other sources."

In practice, the verification typically consists of a limited comparison of the depreciated replacement costs to the structure value obtained from other means. Sample sizes are normally limited and are frequently purely random in nature. Some districts, such as Mobile, have stratified the sample to ensure that the proportion of each significant structure type is adequate. The use of sampling in the comparison of structure value also allows the analyst to establish a quantifiable measure of the uncertainty in the estimated values. Throughout this chapter, various statistical terms and formulas are utilized. For precise explanation or definition of these items the reader should refer to a standard statistics text book. The applications included in this text just scratch the surface of possible analyses.

Sample Design Considerations

Before sampling to test the validity of any secondary data sources as being an accurate representation of depreciated replacement value, the analyst should consider the potential causes of variation in structure value. Anticipating the reasons why market or tax data may not approximate depreciated replacement value provides the opportunity to design a sample which controls for the expected influence. Such influences may be financial, environmental or social in nature, but are similar in that market premiums or discounts reflect conditions external to the physical resources of lumber, steel and labor comprising depreciated replacement value. In any case, where the floodplain structures are not homogeneous, it is desirable to use a stratified sample to ensure that each significant structure category is represented.

The following issues should be considered when identifying categories into which the sample should be subset:

- Building types which may be valued differently by the market, such as residential vs. commercial structures.

- Buildings in different communities which could reflect different sources of data, i.e., different assessors or realtors, or may reflect market differences due to tax rate impacts or a different trend in the affluence of the communities.

- The date of construction is significantly different, possibly indicating differences in construction standards and effective age.

- Frequency of flooding, the perception of which could influence market trends.

Flood damage reduction benefits and benefit cost ratios are evaluated separately for levees on the left and right banks of a river. These project elements could be implemented jointly or separately, and the NED alternative which maximizes benefits in excess cost is normally recommended. In many instances, the river being analyzed forms a boundary between distinct groupings of economic affluence or between political subdivisions. Any such division may affect the market perception of the buildings, resulting in potentially different market premiums or discounts on opposite sides of the river.

If, for example, the market's reduced willingness-to-pay for structures in a depressed urban environment on one bank of the river were included in the calculation basis of flood damage, the possible result could be to recommend protection for only the more affluent and marketable bank of the river, leaving the opposite bank unprotected. Hydraulic influences of a levee on one bank of the river may actually increase the severity of flooding on the opposite, unprotected side.

When testing whether market data is appropriate for use on this project, depreciated replacement cost samples should be taken on both banks of the river in order to properly account for externally driven fluctuations in market value. The ratio of depreciated replacement cost to market value should be established for each structure sampled and the mean and standard deviation of the ratio should be calculated separately for either bank. If necessary, value adjustments may then be varied between banks of the river.

When establishing a sample size, the analyst must balance the desired level of accuracy against study costs and schedule. To establish a sample size for estimating the mean relationship between primary and secondary sources of structure value, the analyst must:

- specify a level of confidence (risk);
- specify a level of precision (tolerable error); and
- estimate the variability of the population.

If, for example, the economist is willing to accept a 90% confidence level and a potential 5% error in the mean ratio of the data sources, and assuming that the ratio between depreciated replacement cost and market data techniques has a coefficient of variation (standard deviation ÷ mean) assumed to be 20%, the sample size may be estimated using the formula:

$$n = \frac{Z^2\ CV^2}{e^2}$$

where: Z = 1.64 for 10% level of risk, i.e., confidence level of 90%
CV = .20 assumed coefficient of variation of 20%
e = .05 accuracy level of 5%

The sample size n is calculated to be 43 structures.

Since the coefficient of variation in structure value ratios was only estimated to select sample size, the actual level of precision and confidence will vary in accordance with the measured variation.

One method of limiting sample size requirements is to perform an initial pilot survey to more accurately predict the sample variance. Analysis of these interim results provides a basis for determining the need for additional data.

Data Testing

The data test procedures presented in this section are designed to provide a measure of the accuracy of secondary data sources, such as tax assessments, in predicting depreciated replacement value. The procedures presented utilize the ratio of depreciated replacement costs to the values obtained from the secondary data source, incorporating the inherent uncertainties of both data sources into the uncertainty in their ratio. This assumes that any errors in both the depreciated replacement cost and the secondary data are random and do not tend to magnify or lessen the variance of the value ratio.

The initial data test is to determine whether the secondary source of structure value results in a biased estimate of depreciated replacement costs. The secondary data is considered unbiased if the mean ratio of values is reasonably expected to be equal to 1.0. Based on results of the sample comparison to depreciated replacement cost data, the analyst may then determine the probability that the true population mean ratio of values is equal to 1.0.

If the probability of the population mean ratio being equal to 1.0 is small, the conclusion is to reject the assumption that the secondary data may be used without modification. This simple procedure tests whether μ, the population mean, = 1.0. This condition is referred to as the null hypothesis. The alternative hypothesis is that $\mu \neq 1.0$. The hypothetical problem in Table 30 presents an example of such a hypothesis test.

Where the sample comparison indicates that the secondary data does not accurately represent depreciated replacement costs, survey results provide the basis for adjusting the data. The secondary data may be adjusted to approximate depreciated replacement costs by simply multiplying the secondary data by the ratio of values.

Estimating Uncertainty for use in Risk-Based Analyses

From the perspective of risk-based analyses, the comparison of values developed by different procedures may be considered similar to an audit in which a sample of data is evaluated to estimate the overall accuracy of the data. For studies in which secondary data form the initial estimate of structure value, the variance or standard deviation of the ratio of values may be used to define uncertainty. This measure of uncertainty combines the inherent variation of both analysis techniques and the uncertainty of

Table 30 - Sample Test Application

For a theoretical study, market value data are readily available from local tax assessors. Prior to accepting these data for the flood damage analysis, depreciated replacement costs and the ratios of depreciated replacement costs to market value were calculated for a sample of ten structures. Assume we will reject the direct use of market data if we are more than 80% certain that depreciated replacement cost techniques estimate a structure value different than the market data.

On average, the sample buildings have a depreciated replacement cost 22% greater than the market value, a mean ratio of 1.22. The sample standard deviation of the ratios was calculated to be 0.25. Assuming that ratios of structure values are normally distributed, the student *t* distribution* may be used to describe the sample. Measuring the difference between the sample and the assumed population mean, the *t* statistic is calculated as:

$$t = \frac{\overline{X} - \mu}{S/\sqrt{N}}$$

where: X = the sample mean = 1.22
μ = assumed population mean = 1.0
S = sample standard deviation = .25
N = sample size = 10

The resulting *t* value is 2.78 with N-1 degrees of freedom.

Referencing a standard student *t* distribution table, the critical value of *t* with nine degrees of freedom for a two-tailed test at a 20% level of significance is 1.38. This indicates within the bound of $t = -1.38$ to $t = +1.38$, there is an 80% chance that the population mean = 1.0. Since our calculated *t* of 2.78 is well beyond the acceptance range, we reject the direct use of market data for this study and have to make provisions to adjust the market value data for application.

*Student was the pseudonym of W.S. Gosset, who was statistician at Guinness' Brewery in Dublin and first derived the *t* distribution.

the ratio into a single value. This distribution of uncertainty is compatible with standard risk-based analysis tools such as @ Risk.

Where depreciated replacement costs are evaluated directly from windshield type structure surveys, detailed estimates from a sample of structures may be used to verify results to determine the accuracy of the estimates. This comparison may be performed using the same techniques described for testing secondary data. The variation in ratios of depreciated replacement cost to alternative valuation sources such as actual cash value (ACV) analysis included in insurance claims, may be used as an indicator of the uncertainty in structure value.

Glossary

Actual Cash Value (ACV) - Replacement cost of an item less its physical depreciation.

Base Unit Cost - Basic cost per square foot of item excluding any adjustments.

Constant Dollar Values (Real Dollar Values) - Series of dollar values such as gross national product, personal income, sales, or profits from which the effect of changes in the purchasing power of the dollar has been removed.

Curable - relates to the principle of contribution and implies that an "adverse effect on value" can be corrected at a net cost in excess of the value of the contribution of the correction to the property.

Demand - The amounts of a commodity that buyers are willing to purchase at varying prices.

Depreciation - The loss of value caused by deterioration and/or obsolescence. Deterioration is noted in wear and tear, decay, or structural defects. Obsolescence is either functional or economic.

Depreciated Replacement Value - The replacement value of a structure less the value associated with deterioration and functional obsolescence. As applied in the context of this document, it is the structure's value in the pre-flood condition.

Depth-Damage Relationship - The expected amount of damage in dollars, or as a percentage of value, for each foot of flooding above or below the first floor of a structure, or for outside property, for each foot of flooding above the ground.

Economic Obsolescence - The adverse effect on value caused by factors outside the property by specific detrimental influences or from the market's lack of value recognition for this type of property.

Effective Age - The actual age less the age which has been taken off by structural reconstruction, removal of functional inadequacies, renovations, modernization of equipment, etc. The age which indicates a true remaining life for the property based on the typical life expectancy of buildings or equipment of its class and usage.

Flood - Water flowing or sitting (above ground) from the overflow of a body of water, rise in groundwater, or ponding of water outside of its usual confines.

Flood Damage - Broadly defined as the total monetary value of all physical and non-physical losses due to flooding and the threat of flooding.

Flood Frequency - The number of times per a specified period on the average that floods of a certain magnitude are exceeded.

Floodplain - The areas adjoining a river, stream, ocean, lake or other body of standing water that have been or may be covered by floodwater.

Frame (in statistics) - Means of access to the population. The frame is a list, a map or a set of instructions which allows the user to obtain access to each element of the population to which the tests are administered.

Frequency (in statistics) - The number of occurrences of a particular variable within a given sample or population.

Functional Obsolescence - The adverse effect on value due to defects in the design that impair utility including, poor layout, height and bay restrictions, or other detrimental impacts within the property. This condition may be "curable" or "incurable".

Incurable - Implies that to repair or otherwise cure the condition is not economically feasible or profitable as of the rate of variation.

Market Value - Market value, in its purest sense, is the average cash or other term selling price of an infinite number of identical property interests which were sold at the same effective date of the appraisal in a freely competitive market. However, this is not a realistic definition. Therefore, fair market value is often utilized as the market value. Fair market value is the property's most probable price in a competitive and open market under all conditions requisite to a fair sale. In a fair market, the price shall not be affected by undue stimulus and the buyer and seller shall each be well informed, well advised, and acting prudently.

Percent Good - The percent of value remaining after depreciation. Present value of item divided by its replacement cost.

Precision - The standard error of the estimate. A measure of the reliability of the methodology of selecting the element of study from the population for inclusion in the sample.

Primary Data - Data that is collected specifically for a given project.

Public - A category of general property including civic centers, courthouses, schools, institutional property, utilities, transportation, military bases, park facilities, and others owned by public or quasi-public jurisdiction.

Remaining Life - The normal remaining life expectation. The length of time the structure may be expected to continue to perform its function economically at the date of the appraisal.

Replacement Cost New - The current construction cost of a similar new item having the nearest equivalent utility as the property being replaced at the time of the appraisal.

Reproduction Cost New - The current cost new of duplicating an identical item or reproducing an exact replica, including all of the item's deficiencies, superadequacies, and obsolescence.

Residential - A category of general property including single family and multi-family residences, owned by the residents individually or cooperatively by corporations, by government agencies, or landlords.

Risk - In cost-effectiveness analysis and operations research, characterization of a situation when it is possible to describe all possible outcomes and to assign objective numerical probabilities to each.

Sample - A subset of elements of study in a population; a portion of the population.

Sampling - Process of determining characteristics of a population by collecting and analyzing data from a representative segment of the population.

Secondary Data - Data that were collected for another project. Since those data were not collected for the specific project at hand, some information may be missing or irrelevant.

Standard Deviation - Measure of dispersion between actual and fitted values in the equation: the square root of the variance.

Stratified Sampling - A probability sampling procedure in which the frame is divided into categories (strata). The elements of study in the population are then selected at random from each stratum assuring that each category will be presented in the sample.

Supply - The amount of a commodity that producers are willing and able to offer at varying prices.

Uncertainty - Uncertain situations are those in which the probability of potential outcomes and their results cannot be described by objectively known probability distributions, or the outcomes themselves, or the results of those outcomes are indeterminate.

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Appendix A - Survey of Current District Practices

Appendix A
Survey of Current District Practices

Baltimore

Derivation of Damage Functions:
Depth-damage curves utilized by the Baltimore District are currently from updated FIA curves. Baltimore has used the curves from St. Paul District's "Depth Damage System" (DDS). The curves are damage relationships based on post-flood surveys. The DDS relates depth of flooding for actual or hypothetical events to actual dollar damages (not percent damages) for various structure values and characteristics. Damage functions are referenced to the first floor.

Type of Buildings:
The DDS depth-damage curves are differentiated for only one-story structures with and without basements. There is no distinction between one and two-story structures. Additional residential structures covered under the FIA curves include, two-story with and without basement, split level with and without basement, and mobile home.

Structure Value Determination:
Structure value is taken as the replacement value minus depreciation. Although tax assessment data is available which is adjusted to get the market data (minus the land), this was found not to be a true representation of replacement value minus depreciation. Therefore, a construction cost model such as Marshall & Swift is used in determining the structure value. The typical procedure involves randomly selecting a population, examining the structures in the field, obtaining information on the structures from the tax assessor for size and age of construction, etc., and entering the data into the Marshall & Swift program. Quality of construction, size adjustments, multiple units, etc., are accounted for in the Marshall & Swift estimate primarily based on field judgment. Age, condition, and depreciation are accounted for under the determination of "Effective Age". The Baltimore District has developed a schedule based on the exterior condition and quality of construction (utilizing most popular ratings of low, fair, average, good) to assist in determining the effective age of the residential structure. A similar process is being developed for the commercial structures.

Galveston

Derivation of Damage Functions:

Galveston District's depth-damage curves are based on a composite of several post-flood surveys and FIA claims data. Damage functions are referenced to the structure's first floor.

Type of Buildings:

Depth-damage curves are derived for the following residential structure types: one and two-story and split level without basements; mobile home; high raised; one level apartment; and two level condo/townhouse. In addition, retail and non-manufacturing are considered under commercial structures and manufacturing is considered under industrial.

Structure Value Determination:

Structure values are approximated as the replacement value minus depreciation through the use of Marshall & Swift's costruction cost model. Spot checks of these values are performed by contacting local realtors and appraisers. Quality of construction, size adjustments, add-ons, etc., are accounted for in the Marshall & Swift estimate primarily based on field judgment. Age, condition, and obsolescence are accounted for based on an average depreciation of 2-3% + per year of structure age as determined by the structure type.

Los Angeles

Derivation of Damage Functions:

Los Angeles District utilizes the depth-damage curves from the Flood Insurance Rate Review, updated annually by FIA. Damage functions are referenced to the first floor.

Type of Buildings:

Five residential structure types are employed by the Los Angeles District: one and two-story without basement, split level without basement; mobile home; and multi-family residences. Commercial structures are examined as in the Marshall & Swift construction cost model.

Structure Value Determination:

Structure values are defined as depreciated replacement value and are determined using the Marshall & Swift construction cost model. Quality of construction, size adjustments, multiple units, etc. are estimated based on Marshall & Swift guidelines and field judgment. Effective age

accounts for the structure's condition and obsolescence. Currently, effective age is determined from tax assessor records and field judgment.

Structure Value Uncertainty in Risk-Based Damage Analysis:

Risk-based analysis is currently being performed based on the class or condition categories (fair, good, excellent, etc.) as derived under the Marshall & Swift construction cost model. The class below and above the structure's classification become the upper and lower limits of the risk-based analysis.

Louisville

Derivation of Damage Functions:

Louisville District typically utilizes the Flood Insurance Rate Review curves updated annually by FIA for residential depth-damage curves and the Galveston District Damage Interviews for commercial depth-damage functions. Additional curves used are derived from post-flood surveys in the Frankfort and Louisville areas may be used for more site-specific curves. Damage functions are referenced to the first floor.

Type of Buildings:

FIA depth-damage curves for residential structures are derived for one and two-story with and without basement, split level with and without basement, and mobile home. The residential structures considered under the Frankfort surveys include one-, one and a half-, and two-story with and without basements, whereas the Louisville survey considers one-, one and a half-, and two-story with basements. One structure category is considered for commercial structures.

Structure Value Determination:

Structure values are estimated as depreciated replacement values using Marshall & Swift construction cost model. For some areas, commercial structure values are determined based on interviews. Quality of construction, size adjustments, multiple units, etc., and age, condition and depreciation are estimated based on Marshall & Swift guidelines and field judgment. The Marshall & Swift program, or a more user friendly in-house adaptation of the M&S program in a lotus spreadsheet, is utilized in deriving the structure values.

Structure Value Uncertainty in Risk-Based Damage Analysis:

Marshall & Swift provides the district directly with the distribution information necessary to do risk analysis.

Mobile

Derivation of Damage Functions:

Mobile District utilizes depth-damage curves taken from the Flood Insurance Rate Review updated annually by FIA and updated as necessary by post-storm data. Damage functions are referenced to the first floor.

Type of Buildings:

FIA depth-damage curves are derived for one- and two-story with and without basement, split level with and without basement, and mobile home. Commercial, industrial, and public structures are also considered.

Structure Value Determination:

Structure values are estimated as replacement value minus depreciation as determined by market data by the real estate section and corroborated by Marshall & Swift. The sample size selected for verification by Marshall & Swift is determined by an in-house statistician depending on the structure group size within the study where the structures are stratified according to the residential type (one-story with basement, etc.) Quality of construction, size adjustments, multiple units, etc. and age, condition, and depreciation are addressed based on best judgment from field assessments and Marshall & Swift guidelines.

Structure Value Uncertainty in Risk-Based Damage Analysis:

Risk-based analysis is performed for residential structures based on the standard deviation in the sample from the market data value and the Marshall & Swift value. Although this method is often used for commercial and industrial structures, these structures often need to be examined on a case-by-case basis since much of the damage is inventory-based rather than structural. For these structures, the minimum and maximum in inventory is often used to assess risk.

New Orleans

Derivation of Damage Functions:

New Orleans District uses depth-damage curves developed for the Lake Pontchartrain Hurricane Protection Study. Each structure was visually inspected and expected damages from various levels of inundation were estimated. Depreciated replacement values for the Hurricane study are based on statistical analysis using market data obtained from the city's Central Appraisal Bureau minus the cost of the land. More site specific curves are currently being developed. Damage functions are referenced to the first floor.

Type of Buildings:

Residential depth-damage curves were derived for one-story, two-story without basements, and mobile home. Commercial structures are also considered. Survey/questionnaires are required for industrial damage functions.

Structure Value Determination:

Structure value is currently defined as the replacement value minus depreciation and is estimated utilizing the Marshall & Swift construction cost model. Quality of construction, size adjustments, multiple units, etc. are adjusted accordingly based on field investigation judgment. Age, condition and depreciation are also adjusted based on field investigation judgment.

Rock Island

Derivation of Damage Functions:

The Rock Island District currently utilizes curves developed from FIA data which were modified based on post-flood damages and surveys. The depth damage curves for split-foyer structures use local survey data only. The reference point for the damage functions is the first floor elevation.

Type of Buildings:

Depth damage curves are developed for seven residential building types including: one- and two or more-story with and without basements; split level with basement; split foyer without basement; and mobile home. Commercial structures are basically grouped together into one category, but remain separate from the residential structures.

Structure Value Determination:

The structure values are currently determined by the licensed appraisers in the real estate section in the Vicksburg District. Tax records, multiple listings, insurance ratings, zonings, etc. and current market data are evaluated. The land value taken from the lot sale prices is then removed from the total value to get the structure value.

Structure Value Uncertainty in Risk-Based Damage Analysis:

Sensivity analysis is performed based on the range of values provided by the real estate section, for example, 10% $\pm$ for residential and 20% $\pm$ for commercial structures.

Saint Louis

Derivation of Damage Functions:

The Saint Louis District utilizes FIA curves modified by post-flood damages and surveys. Some special curves have been developed for unique buildings. The curves are updated based on field surveys, real estate appraisers, consultants, and other sources. The reference point for the damage functions is the first floor elevation.

Type of Buildings:

Residential structure depth-damage curves are differentiated for one-, two or more-story with and without basements; split level with and without basement; and mobile home. Although a few standardizations can be made, commercial and industrial structures are primarily site-specific. Industrial and heavy commercial are difficult since most of the damage sustained is not structural but loss of equipment and inventory.

Structure Value Determination:

The structure value is currently represented by replacement value less depreciation, which is reflected by market data. The market data currently utilized is typically obtained from tax assessor records since Missouri state requires property assessments to be performed every two years. There is an extensive mapping system (often GIS) in which the value improvement and land value are linked right into the maps. When time and budget constraints permit, a small sample is verified using E.H. Boeckh or Marshall & Swift construction cost model.

Structure Value Uncertainty in Risk-Based Damage Analysis:

Factors related to structure value estimation including location, community, flood zone, etc. could be incorporated into a risk-based analysis. Rather than expending time refining the structure value, the district intends to dedicate more time to risk-based analysis on the data.

San Francisco

Derivation of Damage Functions:

The San Francisco District utilizes depth-damage curves based on FIA claims data with an in-house regression analysis performed to obtain several depth-damage relationships. The reference point for use in the damage functions is the first floor.

Type of Buildings:

Residential structure depth-damage curves are established for one-story and two or more stories with and without basement; split level without basement; and mobile homes. In addition, curves are developed for seven commercial structures including one-story, multi-story, warehouse, and public meeting.

Structure Value Determination:

Structure value is currently obtained from market data minus the cost of land. Market data is obtained from residential surveys and tax assessments. The tax assessments are adjusted based on the California values, then compared and adjusted based on the survey results to yield an estimate of structure value. A small sample size (10 properties $\pm$) are then verified using Marshall and Swift to validate that the results reflect depreciated replacement value. The majority of the studies performed using this methodology have, on the average, resulted in the Marshall & Swift value being similar to the estimated structure value. When utilizing Marshall & Swift, the effective age is determined based on the condition of the exterior of the structure.

Vicksburg

Derivation of Damage Functions:

The Vicksburg District utilizes curves developed for the Lake Pontchartrain Hurricane Protection Study in which the contractor visually inspected each structure and estimated expected damages from various levels of flooding. In addition to these curves, curves from the Huntington District and Tennessee Valley Authority (TVA) are also used. The reference point for the damage functions is the first floor elevation.

Type of Buildings:

Depth-damage curves are developed for up to 15 residential building types and values including: one-, two-, and multi-story with and without basements; split level; and mobile home. The curves are differentiated by type of building including: brick, frame, slab, pier, etc. and flooding type (fresh versus saltwater). Commercial structures are basically grouped together into one category, but remain separate from the residential structures.

Structure Value Determination:

The structure values are currently determined by the licensed appraisers in the real estate section. Tax records, multiple listings, insurance ratings, zonings, etc. and current market data are evaluated. The land value taken from the lot sale prices is then removed from the total value to get the structure value.

Structure Value Uncertainty in Risk-Based Damage Analysis:

Sensitivity analysis is performed based on the range of values provided by the real estate section, for example, 10% ± for residential and 20% ± for commercial structures.

Appendix B - Preliminary Survey of Tax Assessor Offices

Appendix B
Preliminary Survey of Tax Assessor Offices

Wayne Township, New Jersey

Frequency of Assessments:

The latest reevaluation assessment was performed in 1991 and entered into the records in 1992. The previous reevaluation was in 1975 or 1976.

Relationship of Assessed Value to Market Value:

The State of New Jersey provides the approximated ratio/percentage of market value to assessed value for each community. The assessed values are approximated as 97.48% of the 1994 market value. This percentage is applied to the total assessed value; there is no separation between structure and land values.

Assessment Data:

The assessments were performed by the contractor on a computer program adapted for the town based on the state manual for assessments. An assessed value is included for land and improvements (structure). The assessments contain a significant amount of structural information including: dimensions of the structure; square footage of the living space; attached structure information; room count; basement description - finished, unfinished; quality of the structure; etc.

City of Paterson, New Jersey

Frequency of Assessments:

The latest reevaluation assessment was performed in 1972. Assessments are performed for all new construction since 1972. There is no established time schedule for reevaluation assessments. Houses purchased in the interim may be reassessed based on the purchase price. This results in assessments based on different price levels.

Relationship of Assessed Value to Market Value:

The State of New Jersey provides the approximated ratio/percentage of market value to assessed value for each community. This percentage is applied to the total assessed value; there is no differentiation between structure and land values. The current ratio is 21/71.

Assessment Data:
The assessments were performed based on the state manual for assessments. An assessed value is included for land and improvements (structure). The current assessments contain structural information including: dimensions of the structure; square footage of the living space; stories, attached structure information, etc. Anything new is assessed as new, otherwise the 1972 assessments took into account physical depreciation and functional obsolescence.

Fairlawn Township, New Jersey

Frequency of Assessments:
The latest reevaluation assessment was performed in 1988 with no revisions unless the assessment was appealed.

Relationship of Assessed Value to Market Value:
The State of New Jersey provides the approximated ratio/percentage of market value to assessed value for each community. This percentage is applied to the total assessed value; there is no differentiation between structure and land values. The assessed values are approximated as 97.46% of the 1994 market values.

Assessment Data:
The assessments were based on the state manual for assessments. An assessed value is included for land and improvements (structure). The assessments contain a significant amount of structural information including: dimensions of the structure; square footage of the living space; attached structure information; room count, etc. Percent good is considered in the quality factor applied to the structure.

Montpelier, Vermont

Frequency of Assessments:
The State of Vermont requires reassessments to be performed once the assessment value is less than 80% of the market value. Some communities in Vermont must perform the reassessment every five or six years whether the assessed value is less than 80% of the market value or not.

Relationship of Assessed Value to Market Value:
The State of Vermont provides the approximated ratio/percentage of market value to assessed value for each community. This percentage is applied to the total assessed value; there is no separation between

structure and land values. The assessed values for Montpelier are approximated as 80%+ of the 1994 market values.

Assessment Data:
An assessed value is included for land and improvements (structure). The assessments contain a significant amount of structural information including: dimensions of the structure; square footage of the living space; attached structure information; room count, etc. Physical depreciation is built into the computer program used for assessments in which a schedule was developed based on age and condition (similar to Marshall & Swift). Functional and economic depreciation are input by hand once the structure has been evaluated in the field.

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13. ABSTRACT *(Maximum 200 words)*
This report documents alternative procedures for determining residential and business structure value and the applicability of each of those methods for use by the U.S. Army Corps of Engineers in flood damage reduction studies. Reproduction cost, replacement value, depreciated replacement value, market value, and income capitalization methods are described and analyzed. The report reviews each method to determine its consistency with the National Economic Development benefit standard and Corps of Engineer procedures for evaluating damages. Practical considerations are detailed for the application of suggested valuation methods. Alternative procedures are detailed for application based on budget and time considerations as well as the availability and usefulness of existing data. The report includes information on sample design and consideration for conducting structure valuation as part of a risk-based analysis.

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